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TANGANYIKA TERRITORY

DEPARTMENT OF AGRICULTURE

Annual Report

1935

1936
DAR ES SALAAM
PRINTED BY THE GOVERNMENT PRINTER
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CONTENTS

SECTION I.

GENERAL REVIEW OF THE YEAR.

NON-NATIVE AND NATIVE DEVELOPMENT.

LABOUR.

IRRIGATION AND NATURAL WATER SUPPLIES.

MARKETING.

PESTS AND DISEASES.

EXPORT CROP ESTIMATES.

NOTES ON THE CHIEF EXPORT CROPS.

OTHER CROPS AND PRODUCTS.

SECTION II.

DETAILS OF ASSISTANCE AND PROGRESS IN THE VARIOUS PROVINCES.

EXPERIMENTAL WORK.

AGRICULTURAL EDUCATION.

SOIL EROSION.

PUBLICATIONS.

SECTION III.

FINANCE.

SECTION IV.

LEGISLATIVE CHANGES DURING 1935 AS AFFECTING AGRICULTURE.

CONCLUSION.

ANNEXURES :—

(i) Report of the Senior Agricultural Officer, North-Eastern Circle.
(ii) Report of the Acting Senior Agricultural Officer, North-Western Circle.
(iii) Report of the Acting Senior Agricultural Officer, South-Eastern Circle.
(iv) Report of the Chief Scientific Officer i/c Coffee Research and Experimental Station.
(v) Report of the Sisal Experimental Station.
(vi) Report of the Morogoro Experimental Station.
(vii) Report of the Mpanganya Experimental Station.
(viii) Report of the Lubaga Experimental Station.
(ix) Report of the Ukiriguru Experimental Station.
(x) Report of the Iheme Experimental Station.

APPENDICES :—

(i) Staff List.
(ii) Plant Introduction.
(iii) List of Ginneries.
(iv) Rainfall Records of Experimental Stations.

DEPARTMENT OF AGRICULTURE

ANNUAL REPORT, 1935

SECTION I.—General Review of the Year.

While the rainfall and general climatic conditions for the year showed appreciable improvement over the past two or three seasons, in a territory of this size, with its wide range of altitudes and diversity of crops, it is not surprising that all crops did not enjoy optimum growth conditions. The early long rains were fairly heavy and of satisfactory duration for the coffee, groundnut, tea, sisal and all grain crops; they were somewhat prolonged and adversely affected the cotton crop especially in the coastal provinces. In the Southern Province an early cessation of the rains adversely affected production. Drought conditions were experienced only locally in the Biharamulo district, resulting in the loss of a portion of the native tobacco crop and, towards the end of the year, in the Rungwe district of the southern highlands. The short rains were fairly heavy on the coast causing some damage to late-sown cotton; in the Lake Province, however, December planting rains were poor.

Floods were experienced in the Rufiji district; these were not so disastrous as in the year 1930, but caused the loss of a great deal of rice. Food crops were also flooded by a rise in the lake level in the Rungwe area of Lake Nyasa.

Grain and other foodstuffs were generally in abundance, and in no place can it be said that famine conditions prevailed. Owing to the campaign during the past four years for the planting of such subterranean crops as cassava and sweet potatoes, most areas are now well protected against famine; it is important that this security be maintained.

From the economic point of view, the past five years have been the most critical in the history of the Territory, and the year 1935 can be taken as the culminating point of the effort that has been made to place the Territory in a position of economic security. The volume of exports attained has never before been approached, the total for the principal export products amounting to over 150,000 tons as compared with less than 100,000 tons in 1931. During the four years of the increased production campaign, record export figures for most crops have been reported year after year, only to be exceeded again in the following year. The period under review is no exception, for records are again to be reported under the three premier industries of sisal, cotton and coffee, while the exports of groundnuts, beeswax and sesame closely approach the maximum output previously obtained. Copra alone is disappointing, on account of low prices and the damage which the coconut trees suffered for several years from locusts and the droughts of 1933 and 1934.

The soundness of the policy of increasing production in a territory which has not nearly reached the limits of development in relation to either the human or the land factors, is not only seen in the higher standard of living and the greater purchasing capacity attained by the native peoples, but is also vindicated by the fact that since 1932 there has been a steady upward trend in the values of the Territory's exportable commodities. In 1932 the average

f.o.b. value per ton of the Territory's agricultural exports was Shs. 318/-, this rose to Shs. 322/- in 1933 and Shs. 331/50 in 1934, while the f.o.b. value for the year under review amounted to Shs. 377/-.

There is no doubt that the increased production campaign has resulted in a higher and happier standard of living for the peasant cultivator. Also he has taken a greater interest in the marketing side and the demand for agricultural assistance and advice has been most prominent in areas of greatest production of export crops. In short, it can be said that the "plant-more-crops" campaign has proved to have had a considerable educative value in addition to its material and economic effect. This is of importance to the future welfare of the people, for this Territory has no monopoly of any class of product, and it is essential that production of quality, as well as of regularity of supply, be a primary consideration if the material essentials to prosperity and so to progress are to be ensured. Education, instruction and demonstration will be needed, and for the purpose of supervision a close and friendly contact with the peasantry is essential. The past year has amply demonstrated that it is the hard working native having a spending capacity above the average who most confidently follows proferred advice and so offers the best medium for demonstrating the methods of improved husbandry.

Where world-wide restriction of plantings of a specific crop is under consideration, producers in this Territory are willing to discuss the matter on an international basis ; tea has been dealt with in this manner.

Non-Native Development.

The more cheerful outlook anticipated for sisal in the last annual report has been realized beyond the most optimistic hopes ; the price of sisal hemp at the beginning of the year was but £15 per ton, considerable excitement occurred in the market from the middle to the end of the season when the price rose to £28 10s. A good deal of rejuvenation of estates, re-equipment of factories and general reorganization of the industry has thus been rendered possible ; but it will be some time before *every* grower will feel the benefit as many had sold forward at low prices. The coffee industry suffered what must be the worst year in its history as far as prices were concerned and little or no new development took place, but a record crop was attained. A coffee curing works was erected at Moshi. In the Northern Province much tsetse-infested land on the lower slopes of Kilimanjaro was cleared for European maize production, the area under cotton grown by non-natives also showed an increase especially in the newly opened Mbugwe area in the Mbulu district of the Northern Province. Good progress has been made by the tea growers, who now come under the world restriction of planting scheme ; the Territory's tea areas are so newly developed, however, that restriction may mean no more than reasonable and normal development. There are now four tea factories operating within the Territory. Tobacco production and curing was increased. A sugar factory was erected in the Northern Province ; the cane is grown under irrigation and costs of production are stated to be low. Production was only for local consumption during the year ; the output for export in 1936 is estimated to be four thousand tons ; the intention is to ship yellow "96" sugar for refining in Europe.

Well over ninety per cent of the Territory's non-native agriculture is on a one-crop basis ; this is unsound both agriculturally and economically. There is, however, a welcome tendency for planters to adopt more diversified farming

methods; ramie and derris hold out promise, tinned meat and fruits are now prepared for the local market. Commonplace products such as groundnuts could also be advantageously included by the planter in his farming rotation, while the heavily protected rice crop is a most profitable one to grow. Lemon-grass oil and bitter-orange oil are now produced commercially. Mining offers new markets for foodstuffs, but with the exception of wheat, it is mainly the native grower who is taking advantage of them and there is need for organization of purchasing and storage. The local market has been and will be further extended by increased peasant production especially of such crops as cotton, and the territorial market should be more carefully nursed by the tea and sugar interests.

Organizations representing the sisal, coffee and tea planters throughout the Territory are now in existence, while the maize growers of the Northern Province have formed an association to further their interests in co-operation with the Kenya Farmers' Association. Such territorial associations are of the greatest value and their formation can be taken as a determination on the part of the producers, irrespective of race, nationality or creed, to co-operate amongst themselves and with Government, for the benefit of the several industries as a whole.

The advisory boards for sisal, coffee and cotton have proved a valuable liaison between the various industries and Government. Grateful acknowledgment is made to those gentlemen who have devoted so much time to the work of these boards and for the valuable advice they have given to this department. The Cotton Advisory Board was reappointed at the beginning of the year. The Coffee Advisory Board is being reorganized, following the centralization of the local coffee associations under one territorial association.

Native Development.

In regard to recent progress in the economic development of the native, some would hold that there is over-production and hence that it is not sound to raise the peasants' standard of living by stimulating a greater degree of production. However, merely because the science of production has temporarily out-stripped the organization of distribution, this can hardly be taken as a reason why the lower standard should be adopted and there is every indication that the methods of collection and distribution are now receiving some measure of rationalization throughout the world. In any case the fact remains that the native of this Territory has received considerable benefit from the policy which has been followed and, almost equally, manufacturing countries have been assisted by the higher purchasing power of the peasant cultivator who, even in the highest producing areas of this Territory, is still occupied far less than most other agricultural or industrial workers in the world.

Native development has again been most outstanding in the Lake Province: new records of exports are to be recorded for cotton and coffee, while the production of groundnuts and rice has been maintained. Sound progress is to be reported especially in the Northern and Tanga Provinces as well as in practically all districts of the Eastern Province.

The concentrations of population, effected two years ago in sleeping sickness areas, have advanced beyond expectation. In addition to the protection and medical care now rendered possible, the concentrations are becoming economic units and almost for the first time in their lives the people have money to spend and traders are opening shops in what were practically derelict areas.

To one who traversed the poverty-stricken tsetse areas some years ago, the change is remarkable and reflects the greatest credit on those concerned in the movement and establishment of the people. For a parallel one must turn to the "famine" districts of Handeni and Bagamoyo, where cassava planting has assured the food supplies of the people who have now turned with some enthusiasm to cotton growing and where to-day there is more contentment than heretofore.

Encouragement and assistance has been given in the realignment of irrigation furrows, especially in the Pares and Mbugwe in the Mbulu district, resulting in increased output of both rice and cotton ; a wider use of half-moon catchments for rice cultivation is seen in the Lake Province. The output of Songea fire-cured tobacco has been trebled, but that of Biharamulo suffered from drought. The progress of the young native coffee industries in Bugufi, Rungwe and Songea has been steady and sound ; in all cases native authority rules are imposed to control cultural methods. With sesame, the staple crop of the Southern Province, methods have been devised to ensure supplies of pure white seed commanding a generous premium over the buff coloured kinds. The demonstration copra-kilns erected in Dar es Salaam have proved their worth, they are cheap to build, easy to run and give a much superior product to that prepared by the normal sun-drying methods.

In the year 1933 "ideal native holdings" were started near the Ukiriguru Experimental Station in the Lake Province ; the aim being to identify the peasant more closely with one cultivable area instead of having scattered plots in densely populated areas, or shifting cultivation in undeveloped country, and to make proper and full use of the cattle which so far are merely a means of hoarding wealth to the detriment of the land on which they graze. In short, the policy was to establish a class of mixed farmers. Much as the word "ideal" was disliked, it was used in the first instance to stress the fact that the aim was a very high one. Progress was expected to be slow, but it was considered that any attempt to force the pace could only result in mistakes which would discourage further effort. The people of the Lake Province were quick to see the advantages of mixed farming on the lines laid down—too quick in fact, for the demand for lay-outs of such holdings, in densely populated areas and in areas of tsetse reclaimed and other virgin bush, is now too great for effective supervision. It is the natives who are now forcing the pace to an embarrassing degree.

The organized settlement schemes at Uzinza, Lake Province, and Kingolwira, Eastern Province, generously financed by the Empire Cotton Growing Corporation, have as their basis mixed farming by peasant holders. Uzinza lies to the south of Lake Victoria ; hitherto it has been undeveloped and uninhabited. People from the densely populated Mwanza district are emigrating to Uzinza, and as far as is possible they are settled on holdings, following an organized plan, round the central cotton farm established as an extension to the Ukiriguru Experimental Station in the Mwanza district. An area of forty square miles of unoccupied tsetse-infested plainland has been reserved in the Eastern Province at Kingolwira, where a cotton farm has been established as an extension to the Morogoro Experimental Station. The adjoining Uluguru mountains are very heavily populated, and with the increase in population and loss of soil which inevitably occurs in such areas, many people will be forced down to the plains and the aim of Kingolwira is to prepare for this, as well as to attract and establish plainsmen on a more permanent and

attractive basis of farming. Satisfactory progress was made during this, the first year, of the extension farm and organized settlement. Peasant holdings will again be referred to under the heading "agricultural education."

Labour.

When one considers that in the past four years production for export has increased from a hundred thousand to over one hundred and fifty thousand tons, that there has been considerable mining activity, and a period of low prices for the products grown by non-natives, it is not so much to be wondered at that complaints in regard to the supply of labour for non-native enterprise and development have arisen, but that the problem is not more acute. Throughout the "plant-more-crops" campaign the policy has been to concentrate effort especially in those areas which are undeveloped or comparatively so and not to encroach on to normal labour sources; at the same time assistance or advice is given when asked for by whatever race. It is believed that, given suitably attractive conditions of employment and organization of the recruitment, movement and distribution of labour for the basic industries, the effective man-power of this Territory is more than sufficient for all needs. The importance of building up a resident labour force, especially for such specialized industries as tea, cannot be over-estimated. It is sometimes held that the "plant-more-crops" campaign has seriously affected labour supplies, but the peasant cultivator is the family man of thirty years of age and over, while the plantation labourer is younger, generally more adventurous and so wishful to leave his home and see the world. The laziest classes are also to be found between the ages of eighteen to twenty-five and there is no doubt that the legal and other financial obligations of such young men are met by their parents who also feed them. In many areas it is cassava planting, to give the essential security against famine, that has kept the younger men at home.

Irrigation and Natural Water Supplies.

The investigation, by Dr. Teale and Mr. Gillman, of the Geological and Railway Departments respectively, of the water supplies of the Northern Province and their control, was completed during the year. Their published report was considered by a committee of which the Director of Agriculture was a member. The report is momentous, dealing as it does with one of the most vital factors in African life and development. In their report, the investigators refer to the time factor and hold that educational and persuasive methods are too slow and suggest the necessity for "benevolent but firm compulsion in order to guide people into efforts designed to save them from themselves." The native authorities on Kilimanjaro have already taken action to implement the recommendations made in relation to riverside cultivation.

Assistance has been given to peasant irrigation in the Northern and Tanga Provinces, to lay out new furrows and to realign existing ones to attain greater efficiency in the use of water and a better command of the land. The Ruvu (Pare district) irrigation scheme received further consideration and it has been decided to carry out irrigation of an experimental area, especially to test soil drainage in relation to alkali; pumps have been installed. An experimental area near Mwanza has been irrigated by means of a power-driven pump with results so spectacular that extension of the intensive methods is bound to follow. Natives have also been encouraged and assisted to provide catchment and storage dams in the Lake Province.

Marketing.

The subject of local marketing received extended reference in the reports for the years 1933 and 1934. There is no doubt that in present circumstances unnecessary charges in the production and realization of crops must be eliminated if the grower is to receive a return sufficient to induce him to continue to produce; furthermore, under the highly discriminating world markets of to-day reliable standards of quality, uniformity and consistency of supply must be developed and maintained. The desire of all those engaged in production is stability as given by an assured market for the produce grown at an assured price, and although world markets are beyond the influence of the peasant producer of this Territory, local marketing methods can be rationalized in such manner as to embrace those elements which tend to produce regularity and quality of supply as well as to satisfying the producer that he has received a fair deal. The local booms and slumps which often have been a feature of the past, irrespective of world prices, are nothing but an evil to be avoided.

The native authority export produce markets, as utilized in the Lake Province since 1932, and which received so much adverse criticism in the first year or two, have proved satisfactory to the grower and trader alike and have given stability to production. The method of auctioning buying booths within such markets is flexible; the number of buyers can be restricted within the capacity of production; cut-throat competition is eliminated. Inspection and grading of produce can be conveniently carried out, and above all satisfaction is given to the peasant producer.

It is admitted by most of the interests concerned that the old system of cotton markets, as followed in the Lake Province and in the Morogoro and Kilosa districts of the Eastern Province, is not suitable under present-day conditions, and the extension to cotton of the export produce market system is under consideration for these areas; reorganization can be carried out in the near future as the leases for cotton buying plots have either expired or will do so within the next year or two.

The advantages of bulk-marketing have been amply demonstrated in recent years by the Bukoba coffee trade where the produce is sold overseas on sample; regularity of supplies according to sample is assured. The inspection and grading service has eliminated the adulteration of coffee with water and other extraneous matter, a practice which seriously affected the position of Bukoba coffee on the world markets. The grading inspector passed 121,208 bags of coffee during the year, the fees amounting to £2,908. It is a tribute to the grader's work that his decisions have not resulted in appeal and relations with the trade have been entirely harmonious. With the approval of the trade, compulsory grading will come into force in 1936. The value of the service is also seen in the increase which has occurred in the exports of coffee (mainly Bukoba) from this Territory to Canada, South Africa and the United States of America between the years 1930 and 1934 as follows:—

	1930 Cwts.		1934 Cwts.
Canada	875	...	43,623
South Africa	2,277	...	18,164
United States of America ...	20,802	...	81,470

The Tanganyika Coffee Growers' Association has kept in close touch with the Kenya Coffee Board in its investigations of the methods of coffee marketing

and, while it has been concluded that London must remain the most suitable market for the disposal of high quality parcels, it is held that it is unwise to glut the London market with the lower qualities which are better sold locally in bulk; coffee sales were held in Mombasa to this end.

The Kilimanjaro Native Co-operative Union is a branch of the territorial coffee association, and has specialized in the bulk-marketing of its members' coffee (there are some twenty thousand native coffee growers). Despite the fact that it is extremely difficult to dispose of mild coffee to-day, the Union sold three-quarters of its crop forward on the basis of the previous years' samples; no arbitration claims were made. Such forward sales are possibly the first, outside Bukoba, to be made from East Africa and represent an important step in marketing methods.

The maize growers of the Northern Province formed an association which enabled them to take advantage of the facilities offered by the Kenya Farmers' Association for the disposal of their crops. The result of this co-operation was extensive development of the maize growing lands round Kilimanjaro. Such interterritorial co-operation to develop both the local and overseas markets is most desirable; the sisal, tea and coffee industries have also indicated that close understanding between East African producers is desirable, if not essential, for their welfare.

The fire-cured tobacco grown by natives in the Songea and Biharamulo districts was sold by the department; a part locally and the remainder in Liverpool. Co-operative societies are contemplated for both areas on the same lines as the Kilimanjaro Native Co-operative Union. Assistance was also given in the marketing of the Bugufi and Rungwe native coffee.

Numerous requests for assistance in finding markets for new products from this Territory have been received and satisfactorily dealt with through the assistance of the Commissioner, H.M. Eastern African Dependencies Trade and Information Office, London.

The internal native market for such commodities as tea and sugar has not received adequate attention. There are nearly one and a half million natives in the Lake Province alone and their spending capacity is yearly increasing; the new mining developments and the sisal industry also offer avenues. There is every need, however, for interterritorial co-operation to direct efforts to raising the consuming power of the native populations and to supply their needs in the most economic and efficient manner.

Pests and Diseases.

Pests.—The Territory has at last enjoyed a respite from locust infestation; it has suffered annually since the year 1928 from repeated invasions of the desert, the red and the migratory varieties of locust. Very large flocks of birds destroyed many swarms and those which escaped were heavily infected with disease, and there were no swarms of any magnitude to report at the end of the year. The policy of protecting standing crops and of attacking all accessible hopper bands has proved economical and successful, actual damage to crops having been comparatively negligible throughout the past five years despite the serious extent and density of the infestations. As a part of the Imperial programme of locust investigation, an officer of the Imperial Bureau of Entomology investigated the conditions in the Rukwa area as a possible breeding ground for the red locusts. The sum of only £1,100 was spent on anti-locust measures in 1935 as compared with £5,600 in the previous year.

Cotton pests were more in evidence than in previous years; pink bollworm, *Dysdercus* species of cotton stainers and *Helopeltis* have all been prevalent and there has been a recrudescence in the Morogoro district of the cotton weevil, *Apion xanthostylum*. It is obvious that the cotton uprooting and burning measures must be tightened up to control these pests more effectively.

Callidea insects appeared to be the cause of much damage to cotton in the Tabora district, while yields were depressed in the Lake Province by heavy infestations of aphis and jassid. It has now been demonstrated that the "leaf-curl" disease of the Lake Province is due to the *Lygus* species of insect.

With coffee in the Northern Province, the communal "block spraying" measures which have been followed for some years against the *Antestia* coffee bug have again proved effective and have gone far to improve the native coffee crop. Thrips were not serious and leaf-miner was severe only on Kilimanjaro. The annual campaign against the *Anthores* coffee stem-borer is now a matter of routine and it is pleasing to note that public opinion is a strong factor in assisting towards freedom from this serious pest. During the past three years over a million wild hosts of borer have been eradicated by tribal and individual effort. Bordeaux spraying against *Hemileia* disease is now more commonly carried out by Europeans; demonstration of the good effects achieved is being made to natives. In Bukoba, the campaign for improved field sanitation has greatly reduced the incidence of the *Stephanoderes* coffee bean beetle, but the position still cannot be regarded as satisfactory.

Sisal growers have been unduly agitated over the sisal weevil, *Scyphophorus acupunctatus*, but they are now more reassured that the advice consistently given since 1921 by the Entomologist in regard to this pest is correct and that in the application of ordinary principles of field sanitation there lies the best economical control of this insect which is not likely to develop into a serious major pest.

The report of the Entomologist is given under Annexure IV; this is of special interest to coffee growers in East Africa especially in regard to his important work on the parasites of the mealy-bug on coffee which has caused serious damage in other East African territories.

Diseases.—The Plant Pathologist has specialized on the root diseases of tea and coffee, *Hemileia* and a peculiar disease of coffee in the southern highlands. His report is given under Annexure IV. With cotton, pests are more important than diseases in this Territory. The incidence of internal boll-rot (*Nematospora* spp.) was high in the coastal provinces due to the climatic conditions which were somewhat unfavourable to cotton. There is still no evidence that black arm is sufficiently in evidence in any area to justify control measures. Leaf-wilt and gummosis in coconuts have caused some concern, but improvement is looked for when the trees have recovered from the ill-effects of several years of locust damage and two years of drought.

Yields of the important native-grown sorghums and millets are seriously affected by smut disease; it is effectively controlled by dusting the seed with flowers of sulphur and this treatment is being widely adopted by natives in the Lake Province and the Kilosa district of the Eastern Province.

Export Crop Estimates.

The estimation of crop production is not an easy matter even under the most favourable conditions, it is very difficult in this Territory where there is no statistical branch and no crop census, and the producers consist of several

European and Asiatic nationalities as well as the native cultivator who is scattered over a vast area (360,000 square miles) under climatic conditions of wide variation and inadequate record. The table below shows the comparison between the estimates given on the 1st April, 1935, and the actual exports of the chief products for the year; it will be seen that only in the case of cotton did the estimate exceed the ultimate results and this was due to the fact that the full adverse effects of the lack of sun during the months of May and July was not demonstrated until the harvesting period. The table is as follows :—

	Sisal Tons	Coffee Tons	Cotton lint Tons	Groundnuts Tons	Beeswax Tons
Estimate issued on 1st April, 1935; Crops surplus for export	80,350	16,010	10,835	15,700	426
Actual export for 1935	82,676	18,588	9,980	16,429	531

Details of the amounts of exports of the chief export crops are given in the following table :—

PRODUCT	Maximum Output for Export prior to 1935		1932			1933			1934				1935			
			Amount	Value per ton f.o.b.		Amount	Value per ton f.o.b.		Amount	Total Value	Value per ton f.o.b.		Amount	Total Value	Value per ton f.o.b.	
	Year	Tons	Tons	£	s.	Tons	£	s.	Tons	£	£	s.	Tons	£	£	s.
Sisal	1934	72,510	60,554	11	10	69,600	12	13	72,510	847,562	11	14	*82,676	1,134,732	13	14½
,, (manufactured)	1934	754	—	—		—	—		754	18,458	24	10	*2,048	52,074	25	8½
Cotton Lint	1934	5,645	3,209	57	5	5,075	54	11	5,645	326,613	57	17	*9,980	569,547	57	1
Coffee	1934	14,766	11,362	40	16	12,718	33	15	14,766	495,237	33	11	*18,588	486,842	26	4
Groundnuts	1933	19,177	15,873	11	9	19,177	8	13	8,036	60,145	7	10	16,429	210,018	12	16
Hides and Skins	1933	4,140	2,718	36	12	4,140	39	11	3,459	134,369	38	17	3,131	153,132	48	18
Copra	1928	9,318	7,265	8	18	8,157	7	12	5,730	32,596	5	14	4,050	38,247	9	9
Sesame	1932	4,811	4,811	10	8	4,441	9	8	3,740	31,150	8	7	4,127	43,606	10	11
Rice	1933	6,293	5,385	11	14	6,293	9	18	6,259	76,626	12	5	4,924	66,917	13	12
Millet and Mtama	1928	7,732	3,529	4	4	2,845	3	15	2,735	12,240	4	9	3,597	15,273	4	5
Maize	1934	2,901	2,823	4	5	868	3	1	2,901	10,378	3	11	1,434	3,580	2	10
Beeswax	1933	680	391	81	15	680	11	77	407	32,707	80	7	531	46,260	87	2
Gums (Copal and Arabic)	1934	1,124	1,033	15	1	1,015	15	0	1,124	22,031	19	12	848	17,375	20	10
Ghee	1913	662	359	46	19	480	41	4	662	26,926	40	13	607	24,477	40	6
Total ...		150,513	119,312	15	18	135,489	16	2	128,728	2,127,038	16	10½	152,970	2,862,080	18	17

*New high record export tonnage.

Sisal.—When sisal prices fell four years ago to an unprofitable level, it was feared that a serious check would be given to new plantings and the development of the industry generally. This did not occur, however, and the exports of sisal have increased since 1932 by some 10,000 tons each year to the record figure of 82,676 tons of sisal hemp to a value of £1,134,732 for the period under review : in addition, 2,048 tons of manufactured sisal ropes and twines were exported to a value of £52,074. During the years of low prices the industry thus placed itself in a position to reap the due reward of the rise in price which occurred beyond the most optimistic hopes in 1935 ; the year opened with sisal at £15 per ton and at the close the price stood at £28 10s. The improvement was due to the clearance of accumulated world stocks and demand was thrown on to the producer. The market was assisted by a heavy grain harvest in America and Russia came into the market towards the end of the year. It is anticipated that the greater part of East African sisal will be absorbed by Europe ; and that there will be increased demand following the investigations which are being made for new uses for sisal and the great care which is now given to the preparation of the fibre by the producer.

The Tanganyika Sisal Growers' Association has carried out much useful work in co-ordinating the opinion of the local sisal industry, in presenting their domestic problems to Government and, through their London committee and the hard fibres section of the British Empire Producers Organization, in maintaining close contact with all aspects which may affect the welfare of the industry. The sisal board operates mainly to advise Government as to the expenditure of the sisal tax funds obtained by a cess of one shilling per ton levied on both manufactured and unmanufactured sisal ; the proceeds of this tax were disbursed to meet a part of the cost of staff, upkeep and capital charges of the Sisal Experimental Station, Mlingano (the Colonial Development Fund also make a contribution to the sisal experimental work), and as a subvention to the association, including a contribution to the Board of Trustees for sisal research in London. Liaison is maintained with the Kenya Sisal Growers' Association by means of a joint committee and, by agreement between the two territories, Tanganyika meets three-quarters of the cost of research and secretarial work overseas ; Kenya paying the remainder. A contribution of £200 is also made by Kenya to the Mlingano Station. On behalf of this Territory the Colonial Development Fund also make a grant towards overseas research which is primarily designed to investigate new uses for sisal in order to increase the demand for this hard fibre : spinning to a finer count and waterproofing the fibre is also a part of the programme which is carried out by arrangement with the Linen Industry Research Association at Lambeg, Northern Ireland. Control of research is given by the local sisal boards through a board of trustees in London.

The following are the figures showing production in the various areas for the past three years :—

	1933 Tons	1934 Tons	1935 Tons
Tanga Province	45,329	40,614	46,755
Morogoro-Kilosa-Dar es Salaam ...	13,964	18,650	22,613
Lindi-Mikindani	7,817	8,359	10,689
Northern Province	2,490	4,887	2,619
Totals ...	69,600	72,510	82,676

The new species of sisal discovered at Amani a few years ago was specifically designated as *Agave amaniensis*; the distinctive appearance of this plant in the field has led to its being referred to as "blue sisal" and it is intended to adopt this name for common usage.

Coffee.—For the third successive year a new record was established in the production of coffee, exports amounting to 18,588 tons at a value (f.o.b.) of £486,842 as against 14,766 tons valued at £495,237 in 1934. The large increase is mainly due to the bumper crops obtained in the mild-coffee producing areas of the Northern Province which increased its output by 3,800 tons over 1934 and eighty per cent more than the previous record of 1933 for that area. In addition, there was a relatively small increase of six per cent in the Bukoba crop which is more akin to Brazilian coffee and is produced in a similar manner by the dry method, while that of the Northern Province and the southern highlands, which competes with the coffees of other Empire countries and with Costa Rica, is prepared by the processes of pulping and fermenting.

Reference has been made above to the serious position of the coffee planter brought about by the disastrous fall in the price of high quality mild coffees. Some relief can be obtained both in marketing and cultural measures: the Tanganyika Coffee Growers' Association is working closely with the Kenya Coffee Board, especially in respect of the methods for local disposal of the lower grades, and it is the object of the coffee research station to demonstrate methods by which the unit cost of production can be reduced. It is obviously uneconomic to maintain a hundred acres of coffee if fifty acres can produce the same amount of crop; a reduction in area, but not necessarily in output, would maintain revenue from coffee and at the same time release land for other crops such as derris and pyrethrum; land would also be available for stall-feeding of cattle and the manufacture of dairy produce could then be followed with advantage.

Cultural methods followed by both native and non-native in the Northern Province have greatly improved in the past few years and the industry is receiving a greater measure of essential organization through the newly formed territorial association and, with natives, by the Kilimanjaro Native Co-operative Union in close co-operation with this department. In Bukoba there is a real need for an association of native coffee growers that will serve to create a public opinion and a sense of responsibility in coffee matters and to stimulate cultural improvement, such as have proved most effective in dealing with the welfare of the native industry on Kilimanjaro; the lack of organization and leadership and the absence of a progressive plantation industry are obstacles to the development of Bukoba native coffee from the condition of a semi-wild cultivation to that of an organized industry.

The figures for production in the main coffee areas in 1935 and the two previous years were:—

Area	1933 Tons	1934 Tons	1935 Tons
Bukoba	7,922	10,210	10,882
Northern and Tanga Provinces ...	4,775	4,379	7,234
Iringa Province and other areas ...	192	177	472
TOTALS ...	12,889	14,766	18,588

The following are the export figures of native and non-native or estate-grown coffee :—

	1933 Tons	1934 Tons	1935 Tons
Native	9,045	11,834	12,944
Non-Native	3,673	2,932	5,644
TOTALS ...	12,718	14,766	18,588

The following are the particulars of coffee inspected and graded at Bukoba during the year 1935 :—

NUMBER OF BAGS OF 200lb.

	GRADED			INSPECTED ONLY		Total exported
	G.A.Q.	F.A.Q.	Triage	Passed for export	Rejected	
Arabica	359	33,908	—	4,449	17,212	38,716
Robusta	123	81,529	777	63	25,494	82,492
					Total ...	121,208

Cotton.—In previous reports of recent years the unsatisfactory nature of the marketing and ginning arrangements for the cotton crop have been described together with the action taken in consultation with the cotton industry to put it on a more stable footing. The measures include the fixing of a *minimum* price and zoning of certain areas, the aim being to eliminate uneconomic rivalry amongst buyers but at the same time to permit a sane measure of competition such as may be warranted by the volume of crop. Touting and the disorderly and extravagant use of motor lorries have been discouraged. The new cotton rules also assure that the ginner is more practically concerned with the development of cotton in the area served by his factory.

Considerable progress has been made but the position cannot yet be regarded as satisfactory, neither can the native be expected to continue to grow cotton with any degree of confidence until the marketing side has been reorganized. In the process of reorganization it is desired to embrace all factors tending to promote the welfare of the industry; those elements which are entirely speculative and adverse to cotton production should be rejected; the grower cannot afford to carry them and he will most certainly avoid them sooner or later. It is recognized that a ginnery provides an essential public service to the cotton industry and that a small crop especially cannot carry inordinate buying charges.

Some ten years ago it was considered that the potential production of cotton permitted the entry of the middleman buyer only in the Lake Province and in the Kilosa and Morogoro districts of the Eastern Province, and leases for cotton store plots were granted for a fixed period of ten years; five years ago it was evident that the system was unsatisfactory and open to abuse and no more rights of occupancy were granted for such market plots. Most of the leases have expired, or will expire within a year or two, and renewals have been made for periods of one year only in order to achieve uniformity and to allow of full

consideration being given by all sides to the organization of a more flexible system of marketing. The proposals for reorganization are based on the experience of four years' working of the native authority export produce markets in the Lake Province. Such a system will recognize the essential nature of the service given by ginnery owners and gives the middleman domiciled within the Territory the opportunity to compete for the right to buy cotton in relation to the amount of crop; it will also permit of the entry of reputable new buyers.

The British Cotton Growing Association has very generously provided two ginnery inspectors who were appointed during the year. One deals with the Lake Province, the other is stationed at Morogoro for the Eastern, Southern, Northern and Tanga Provinces. Their work has already proved the necessity of a ginning inspection service and both officers have given valuable assistance and advice to the ginning industry. With the low cotton output of the first years of low prices, ginners could not be fairly expected to maintain and equip their factories in ideal condition, but as the crop increases a better standard should be developed both in regard to capacity and quality of outturn.

By arrangement with the Empire Cotton Growing Corporation, Mr. H. C. Ducker, Cotton Specialist of the Corporation in Nyasaland, visited the cotton-growing areas of the Eastern, Lake, Northern and Western Provinces in April to May and again in September to October. Mr. Ducker made an exhaustive investigation of the conditions of cotton growing with a view to determining whether a central cotton station was desirable for the Territory. He concluded that the best conditions for such a station lie in the Kahe area of the Moshi district and considered that a central cotton station in that part would serve the whole Territory more advantageously than elsewhere and that its sphere of influence would possibly extend beyond the confines of the Territory.

The substantial financial assistance most generously given by the Empire Cotton Growing Corporation has been referred to in recent reports and is again gratefully acknowledged.

Estate production has been mainly confined to the Kilosa and Morogoro districts. Cotton has been grown on the same land year after year for the past ten to fifteen years and, consequently, yields have fallen to an unprofitable level. Many planters consider that the remedy lies in a change of seed, but it must be stated that better *farming* methods are required with rotation of crops and green-manuring as the basis. New cotton-growing land is being broken up below the Rift Wall in the Mbulu district, but, unless good farming practice is followed, this area will suffer the same soil impoverishment as has occurred in the Eastern Province. Cotton growing under irrigation and rotation with maize and pulse crops has given yields of over a bale of lint per acre in the Northern Province.

In the report for 1934 an output of 50,000 bales (of 400 pounds each) of cotton lint was mentioned as the aim for the period under review; the actual exports for the year amount to 55,888 bales against the previous record output of 31,612 bales in 1934. Given favourable conditions it is anticipated that over 70,000 bales of cotton will be exported in 1936.

As this report is compiled prior to the completion of the season's ginning it is not possible to give the completed figures for lint production, but in the following table approximate figures for 1935 are given based on the seed-cotton production figures for the year, which are also included :—

PROVINCE	Season's production of Lint in Pounds				Seed-cotton in Pounds, 1935
	1932	1933	1934	*1935 approx.	
Lake and Western	3,098,877	6,035,808	10,650,114	15,668,962	50,545,036
Eastern	3,405,945	5,645,278	4,339,701	5,726,630	18,473,000
Tanga & Northern	694,532	261,627	333,407	1,349,678	4,353,800
Southern	16,548	391,120	280,408	296,407	956,154
Total ...	7,215,902	12,333,833	15,603,630	23,041,677	74,327,990

*Based on 31 per cent extraction.

Non-native production for 1935 is estimated at 6,150 bales (of 400lb. each), that is about 10·7 per cent of the total production as compared with 4,540 bales or 12 per cent of the total production in 1934. The following are the figures of non-native production in the various provinces :—

	1934 Bales		1935 Bales
Eastern Province	3,746	...	4,450
Northern and Tanga Provinces ...	720	...	1,280
Southern Province	39	...	100
Other areas	35	...	320
Totals ...	4,540	...	6,150

The sales of seed-cotton by natives during the 1935 season are shown in the following table :—

PROVINCE	Total seed-cotton (Native) lbs.		Approx. value received by grower Shs.
Lake and Western ...	50,168,160	...	5,267,872
Eastern...	12,296,083	...	899,339
Northern and Tanga ...	2,703,800	...	243,342
Southern	831,586	...	66,880

The range of prices in the various provinces is shown in shillings and cents of a shilling per hundred pounds of seed-cotton in the following table :—

PROVINCE	1st Quality		2nd Quality		3rd Quality	
	Max.	Min.	Max.	Min.	Max.	Min.
Lake and Western ...	12/25	10/-	—	—	6/-	6/-
Eastern	11/34	7/26	9/53	5/44	7/26	3/18
Northern and Tanga...	10/43	6/80	9/53	5/-	6/35	2/73
Southern	10/-	7/60	8/20	6/20	5/90	3/91

First and third qualities only are purchased in the Lake Province, except in the Shinyanga district.

Groundnuts.—The amounts of exports of groundnuts show great variability from year to year due to the influence of price on the succeeding year's crop. In 1934 the price was low, the average f.o.b. value being £7 10s., and a great deal of that year's crop was consumed locally ; usually such a poor year is followed by a diminution in plantings, but natives are now better able to understand vagaries of world markets and with the propaganda followed to prevent undue discouragement, an export of 16,429 tons was obtained in 1935, a figure more than double the amount exported in 1934 and only about

1,500 tons below the record production attained in 1933. The 1935 average price of £12 16s. per ton f.o.b. has not been exceeded for several years. Local sales were somewhat adversely affected by a sudden fall in price towards the end of the season, and several hundreds of tons of groundnuts were rendered unfit for export by being bought and railed in a wet condition.

The main producing areas are the Western Province, where a record output was achieved; the Lake Province, where despite the great increase in cotton production, the groundnut crop was above normal; and to a less extent in the Southern Province where production was almost up to last year's record level.

Copra.—A serious decline in the exports of copra has occurred in recent years; only 4,050 tons were exported at an average value of £9 9s. per ton f.o.b. against 5,730 tons in 1934 when the value was £5 14s. and the record production of 9,318 tons in 1928. This decline is mainly due to low prices causing neglect of plantations and even in harvesting. The trees have also suffered serious cumulative damage from both locusts and drought; also greater use is now made of copra in the local manufacture of soap and appreciable numbers of whole nuts are shipped to Zanzibar and Mombasa. The Eastern Province is the largest producing area, followed by Tanga and then the Southern Province.

Sesame.—Sesame is the staple crop of the coastal districts of the Southern Province; only very small amounts are grown elsewhere for export. Four thousand one hundred and twenty-seven tons to a value of £43,606 were exported. The record figure of 4,811 tons was achieved in 1932.

Grains.—Maize plantings were extended in the ~~Western~~ Northern Province and an excellent crop was reaped, but the amounts exported suffered owing to the low world prices; it is now possible to meet the internal requirements of the extensive planting industries in the northern part of the Territory without recourse to heavy importations as in the past. The early cessation of the rains in the Southern Province seriously affected the millet crop. The extremely low prices for grain gave no encouragement for the export market. In the Lake Province the production of rice has been well maintained in face of the competition of the cotton crop. The following are the export figures for the three main grain crops for the past three years:—

	1933 Tons	1934 Tons	1935 Tons
Rice	6,293	6,259	4,922
Millet	2,845	2,735	315
Maize	868	2,901	1,434
Totals ...	10,006	11,895	6,671

Tobacco.—The production of fire-cured tobacco shows a considerable increase by both natives in the Songea district and Europeans in the Iringa district. The total production of fire-cured Virginia tobacco amounted to approximately 437,000lb. as compared with 245,000lb. in 1934 and 90,000lb. in 1933. In addition there is a considerable production of native roll tobacco throughout most of the Territory. The amount of manufactured tobacco exported from the Territory in 1935 amounted to 266,585lb. valued at £38,615 against £66,000 worth in 1934; the total quantity locally manufactured was over 400,000lb., a portion of this was from leaf imported from Uganda. Practically the whole of the European output was sold locally, while forty per

cent of the Songea and Biharamulo tobacco was exported to Liverpool. The production of Turkish tobacco dropped to 4,000lb. in 1935 from 7,000lb. in the previous year.

Given a favourable growing season a further increase in native production is almost certain to occur in 1936 but it is anticipated that this will be offset to some extent by a decrease in the Iringa production as some European planters are turning to other avenues of production especially in connection with the demands of the mining industry.

Tea.—Production amounted to 66,891lb. for the Usambaras, 28,924lb. for Rungwe district and 8,583lb. for Mufindi; manufacture was seriously interrupted in the latter area by alterations to the factory equipment which were found to be necessary soon after the new factory came into operation. Nearly 5,000lb. of the southern highlands tea was sold on the local market, the remainder was exported. A tea growers' association for the whole Territory was formed towards the end of the year and discussions are taking place with the tea associations of neighbouring territories with the intention of forming an East African tea association. The principles under which the tea restriction scheme has been applied are dealt with under the review of the Iringa Province given in Section II of this report.

Other Crops and Products.

Beeswax.—The season was more favourable than was anticipated in the first quarter of the year and exports amounted to 531 tons valued at £46,260; the highest figure is 680 tons exported in 1933. A large increase in wax collection was seen in the Southern Province where better attention is now given to the preparation of the wax. It was mentioned in the last report that consultations regarding the need for inspection and possibly grading had been undertaken, these discussions with the trade were continued and at the end of the year rules were framed which specify that ports and marks for export and movements of wax are controlled in a manner considered to give sufficient protection to the good name of the Dar es Salaam wax without need for inspection or grading. Under the rules no wax can be exported except in pieces not exceeding eight ounces in weight, so that adulteration will be easily ascertainable.

Gums.—The Forestry Department deal with this product. Exports of gum copal and gum arabic amounted to 848 tons; the highest output was 1,124 tons in 1934.

Kapok.—This permanent crop is mainly confined to the Tanga Province, but plantations also exist in the Eastern Province. The trees appear to be recovering from the droughts of the past three years, new plantings have been made and an increase in output is anticipated in the near future.

Citrus.—No real citrus industry exists yet. There are many native trees in the Muheza area of the Tanga Province and there was keen competition during the year to obtain fruit for export to the north-eastern part of Africa. The Bombay market was again tried with an experimental consignment of selected and graded fruit, but the promise of previous years was not borne out. Apparently Rhodesian and South African citrus growers are now developing this market and the produce of this Territory cannot hope to compete with the highly specialized citrus industries of the south. The Southern Rhodesian Citrus Growers' Co-operative Society generously offered facilities, but for some years at least the Muheza oranges will not be up to the required standard.

There is no doubt, however, that the local market is worthy of development and some sisal growers consider a fruit ration of great importance to the health of their labourers.

Essential Oils.—A planter in the Tanga Province is now making use of an old Seville orange plantation (established in connection with the rubber industry, ill-fated as far as this Territory was concerned), for the equellor extraction of bitter-orange oil worth nine shillings per pound. A still is contemplated for the production of *petit-grain* and *neroli* oil. The bitter-orange oil has been received favourably on the market and good orders have been made for the future. In the Eastern Province lemon-grass oil will soon be produced on a commercial basis.

Cacao.—Criollo cocoa of the finest quality is produced in the Eastern Usambaras. Unfortunately, the past interest shown by a prominent firm of chocolate makers has been lost.

Cinchona.—Small quinine plantations exist at Amani and elsewhere in the Eastern Usambaras; the quality of the bark is good and high premiums have been commanded in recent years. The possibilities of extending the cultivation of cinchona are being investigated.

SECTION II.—Details of Assistance and Progress.

The work of the department is decentralized through the circle organizations under the charge of senior agricultural officers. The north-eastern circle includes the Northern and Tanga Provinces where non-native enterprise is most prominent; in this circle are situated the sisal and the coffee experimental and research stations. The north-western circle comprises the Western and Lake Provinces, the latter province being the most densely populated within the Territory, the people being also more industrious than elsewhere; here there are two experimental stations for work on cotton, groundnuts, rice and other grains, native authority farms adjoin them for ease of supervision; there is also a native settlement centre and extension farm. A third circle is the Southern Province, the remoteness of this area and the difficulty of communication requires a senior officer on the spot to prevent delay in dealing with local matters; a small experimental station has been maintained for work with sesame. The work of agricultural officers in the Eastern and Iringa Provinces is directed immediately from head office; no staff is maintained in the Central Province. In the Eastern Province there are two cotton and mixed farming stations, and a settlement centre and extension farm. Reports of the senior agricultural officers will be found in Annexures I to III. A brief review of the work carried out in the several circles and provinces is given below :—

NORTH-EASTERN CIRCLE.

Northern and Tanga Provinces.—The field staff of this circle consists of a senior agricultural officer stationed at Moshi; four agricultural officers at Tanga, Lushoto, Moshi and Arusha; two agricultural assistants are stationed on Kilimanjaro and a district foreman at Handeni. In addition, the coffee research station is situated on the southern slopes of Mount Kilimanjaro, and the sisal research station is at Mlingano, twenty miles inland from Tanga.

Considerable progress, both from the economic and instructional or cultural viewpoint, has been made following the consistent programme patiently but energetically applied over the past five years by officers of the provincial administration and this department. Perhaps in no other part of the Territory

have the chiefs taken such a long view regarding the future welfare of their people, and the native authorities of Kilimanjaro have led the way in the application of anti-erosion rules. A considerable amount of reafforestation has also been organized and carried out. Production of both permanent and annual crops showed a considerable increase, security has been given against famine, trade has increased and there is no doubt that the provinces are now established on a sound and prosperous footing. Native agricultural methods are fast improving under the organization which is given. The sisal industry is most active, and at present prices the Arusha and Moshi sisal estates can produce advantageously. The new non-native sugar, cotton and maize developments have shown much progress; a coffee curing works was erected at Moshi.

The only unsatisfactory feature is the parlous condition of the non-native coffee planter despite the record crops harvested during the year. Coffee prices were comparatively well maintained during the years of the world depression, but during the past fifteen months there has been a disastrous fall and the future appears dark for the industry, especially for that section which bears the heavy burden of capital charges. Native coffee production has increased and, considering the disappointments suffered by all growers in their coffee sales, the Kilimanjaro Native Co-operative Union has come through a difficult year with credit.

A detailed account of the agricultural work and activities of the Northern and Tanga Provinces will be found in the report of the senior agricultural officer which is presented as Annexure I to this report.

NORTH-WESTERN CIRCLE.

Lake and Western Provinces.—The Lake Province is by far the most densely populated province of the Territory, while the Western Province is the most extensive. The staff consists of a senior agricultural officer at Mwanza, with an agricultural officer for each of the following areas: (a) Bukoba, (b) Mwanza, including the Ukiriguru experimental station, (c) Shinyanga, including the Lubaga experimental station, (d) Maswa, Kwimba and Musoma, (e) Tabora, Nzega and Kahama, (f) Kigoma, Kibondo and Ufipa, (g) Biharamulo and (h) the Nyakato agricultural training centre. Agricultural assistants or district foremen are also posted as follows: (a) Uzinza settlement farm, (b) Ukiriguru experimental station, (c) Lubaga experimental station, (d) Kahama, (e) Tabora and (f) Bugufi. A senior agricultural assistant carries out the coffee grading service at Bukoba; a ginnery inspector is also posted to Mwanza. Assistance has been given, especially in the Western Province, by the agricultural surveyors of the Medical Department.

The Lake Province has continued its spectacular progress to a state of prosperity higher than was foreseen. It would be idle to suppose that the rapid material advance of the peasant has not brought its problems, especially in regard to soil management and animal husbandry. Fortunately, however, the moral effect of the "plant-more-crops" campaign has brought the natives to a receptive state of mind and, generally speaking, they are more ready, both individually and tribally, to accept advice and such instruction and organization as may be deemed desirable for their future welfare.

Weather conditions were not good for cotton, yet 40,000 bales were produced as compared with 26,000 bales in the previous year (in 1933 the approximate cotton output was 15,000 bales and in 1932 it was 8,500 bales). The production of groundnuts was largely increased and that of rice was well

maintained. Good seasonal conditions, together with better cultural and sanitation measures, resulted in a record coffee crop in the Bukoba district. The young Bugufi coffee industry can be regarded as a model.

The native authority produce markets have again proved their worth and there is no doubt that the peasant producers would now resist any return to the old systems of trade as far as their export crops are concerned. The extension of the system to cotton, as desired by many of the chiefs, is under consideration.

In the Western Province, despite the low prices of the previous season, a satisfactory recovery was attained, the output of groundnuts equalled the record year of 1933 and 5,000 tons of rice was produced. Effort has been made to establish cotton as a second string to groundnuts with satisfactory results as far as Nzega and Kahama are concerned, but the weather and disease seriously affected the crop in the Tabora area. The concentrations of natives in tsetse areas, formed with the object of protecting them from sleeping sickness, have made satisfactory economic progress, due mainly to the work of the administrative officers. Agricultural assistance has also been given in connection with the desired sleeping sickness concentrations at Kagera in the Bukoba district.

Details of the agricultural work and progress will be found in the report of the acting senior agricultural officer in Annexure II.

SOUTH-EASTERN CIRCLE.

Southern Province.—The staff consists of a senior agricultural officer at Lindi, a district agricultural officer at Lindi, two agricultural assistants for the Mikindani and Songea districts, and three district foremen stationed at Kilwa, Tunduru and Songea. In the coastal districts the rains were below normal and of short duration. The province had enjoyed a bounteous grain harvest in 1934; but unfortunately there was a tendency to rely too much on the stored foodstuffs of that year and natives so delayed their cultivation in 1935 that, with the early cessation of the rains, the grain yields were poor and there was practically no surplus, either for export or for purchase by the local planting industry: sorghums suffered as much as did the rice crop.

The unsatisfactory climatic conditions adversely affected the cotton crop which is still regarded with some antipathy, especially in the Lindi and Mikindani districts, but good results were obtained in the Kilwa district.

Sesame is the staple export crop of the coastal districts; it is not an exacting crop to grow as it can be interplanted in standing grain crops. The seasonal conditions favoured this crop and exports amounted to 4,373 tons; nearly 300 tons above the previous record established in 1933. It has been the department's endeavour to bring about a greater diversity of cropping with cotton and groundnuts as supplementary to sesame.

In the Songea district, tobacco has become firmly established, 106 tons being exported as compared with 32 tons in 1934. The quality was not up to the past high standard, but the new growers should soon gain the necessary experience to improve this. The young native coffee industry is progressing on sound lines; there are no extensive suitable coffee areas in the Songea highlands and sites for coffee planting need to be carefully selected.

An export of 272 tons of beeswax to a value of £23,000 shows a large increase over previous years, and this wild product now takes second place in the native exports of the Southern Province; there has been a welcome improve-

ment in the quality of the wax. Practically half the exports were shipped direct to Europe, whereas previously most of the wax was sent first to Dar es Salaam for purification.

With the improvement in the sisal market, exports of fibre were increased and there was greater activity in plantation regeneration and development programmes.

As with the other circles, full details will be found in the report of the acting senior agricultural officer in Annexure III.

EASTERN PROVINCE.

There is no circle organization for this province. Agricultural officers are posted for (a) the Dar es Salaam and Bagamoyo districts, (b) the Morogoro district, (c) the Kilosa and Mahenge districts and (d) the Mpanganya agricultural station. Agricultural assistants are stationed at Dar es Salaam, Utete, Morogoro and the Kingolwira settlement farm, while a European supervisor is employed temporarily during the planting season for the Kiberege district.

Climatic conditions were generally favourable to all grain and food crops in the Eastern Province, but a dry April, and rains in what should be the dry sunny months of June and July, seriously affected cotton which is the main economic crop of the natives as well as being widely grown by non-natives in the Morogoro and Kilosa districts. Floods in the Rufiji valley destroyed large areas of rice but recompense was given in that conditions became favourable for the "mlao" or mud-flat planting of cotton after the floods receded.

Considering the unfavourable climatic conditions and the depredations of insect pests, the results for the year cannot be regarded as unsatisfactory for the whole province, although some areas have been disappointing. The output of cotton amounts to 14,316 bales, of which 6,000 bales were produced in the Kilosa district. The Rufiji and Bagamoyo districts have made excellent progress and so has Kiberege; all under most difficult conditions. The Morogoro district was the least progressive, there appears to have been a steady decline for some years in the production of all native-grown crops in this district and the export of sisal is less than in the previous year. Complaints were made that cotton planting by natives affected labour supplies, but out of 39,000 taxpayers in the Morogoro district only 11,000 planted cotton in 1935. The Bagamoyo district has suffered periodic famines for many years, the planting of cassava has been encouraged and this has so changed the outlook of the people that a record output of cotton is to be recorded for 1935. Endeavour is being made to establish wheat, groundnuts and sesame in various areas of the province. To 2,580 natives in the Dar es Salaam district 6,070 pounds of cashew nut seed were issued; an exclusive licence has been granted to one firm to develop this crop.

There are few more densely populated areas than the Uluguru mountains, and with the normal increase in population and the serious erosion and waste of soil which is going on, many natives will soon be forced to the plains; as previously stated, it is one of the objects of the Kingolwira settlement farm to prepare for this and to establish the hill-men on peasant-holdings under favourable conditions on the plains; the importance of this work cannot be stressed too strongly.

IRINGA PROVINCE.

The staff consists of an agricultural officer and an agricultural assistant stationed at the Iheme experimental station near Iringa, and an agricultural

officer with a knowledge of tea and coffee at Tukuyu, who also serves the Njombe, Mufindi and Mbeya areas. An agricultural assistant is also stationed at Tukuyu who deals mainly with native agriculture, especially the promising native coffee industry.

Climatic conditions were favourable to general crop production, although the rainfall over the first half of the year was much heavier than has been experienced for fifteen years and the latter part of the year was excessively dry. The close proximity of the progressive Lupa goldfields has changed the whole outlook of the agriculturalist, both native and European, in the Iringa Province. Maize production is on the increase, yet complaints are made each year of a shortage of foodstuffs; actually there are ample, but the grain is mainly bought from hand to mouth, few individuals or companies have storage facilities and not many can afford to purchase well ahead; also the diggers' capacity to purchase is lowest when the crop is coming on to the market. Facilities for storage of grain in bulk and organization of distribution will be necessary if the mining industry is to secure adequate and regular food supplies at reasonable cost.

With the exception of wheat, most of the maize, potatoes, beans, peas and onions supplied to the Lupa during the year were native grown. Attention has been given particularly to the natives of the Ukinga area of the Livingstone mountains as it has good potentialities for grain production to serve the Lupa goldfields. Butter, cheese, pork products, fresh and canned vegetables and fruits are being supplied by Europeans in increasing amounts, not only to the Lupa but also to ships calling at Dar es Salaam.

Certain non-native development has been severely handicapped by financial restrictions in Europe, but the production of wheat for the Lupa has been increased from 120 to 300 tons; it is estimated that existing farms could produce up to 1,000 tons of wheat.

The early promise of Mbosi and Mbeya as coffee growing areas has been satisfactorily borne out. Yields are improving and quality is second to none in East Africa. Four hundred and seventy tons of coffee were exported as compared with 240 tons in 1934. In the Mufindi and Dabaga areas, however, some twenty-five planters have either abandoned, or intend to abandon, coffee cultivation; the department has long maintained that these areas are not suitable to coffee and additional proof is forthcoming in each succeeding year that the warnings given have been fully justified. The progress of the young native coffee industry in the Mbosi and Rungwe areas has been well maintained, 47½ tons of native-grown coffee were produced as compared with 35 tons in the previous year.

There are now about forty tea planters in the Rungwe and Mufindi areas of high rainfall. Under the world tea restriction scheme these southern highlands have a maximum planting allocation of 4,260 acres to be established by 1938. The following principles have been followed in determining the allowances of increased tea plantings:—

(i) No allocation to be made to anyone who was not engaged in tea planting prior to 1933.

(ii) Estates complete with factory were allowed to plant to a maximum of 500 acres in one case and 350 acres in another.

(iii) Estates with an area of tea established before restriction began were allowed up to 100 acres. These estates are designed to serve a central factory.

(iv) A few bona fide planters who came to the Territory with the express intention of producing tea were allocated from twenty to forty acres.

In order to ensure full and economical development it was laid down, in consultation with planters' associations, that half the maximum allocation must be planted before May, 1936, when the position will be reviewed.

The drought in the latter part of the year and an unfortunate set-back in the factory arrangements depressed production which amounted to 28,924lb. from the Rungwe district and 8,583lb. from Mufindi. The quality of the tea has not fully come up to expectations; prices ranged from tenpence to one and fourpence per pound. Three factories are now operating in the southern highlands. There have been labour difficulties, which will not be wholly cured by the payment of higher wages; the natives of the area are not yet accustomed to work for a longer period than is necessary for a bare existence. The problem will become more serious in the future and early attention should be given for the recruitment and training of a resident labour force.

European production of fire-cured Virginia tobacco was increased from 103,000lb. in 1934 to 152,000lb. for the year under review. This was mainly sold to the Dar es Salaam tobacco manufacturers at prices of Shs. 1/20, Sh. 1/- and 60 cents for the respective grades; purchasers say that there is room for improvement in the quality. Approximately 26,000lb. was sold to the Lupa and disposed of locally. Efforts were made by planters to establish tobacco in the Mufindi and Dabaga areas with disappointing results. The exacting cultivation of Turkish tobacco was reduced by about half: 4,000lb. only being sold at Shs. 1/50 per pound. There is a further increase in the production of native roll tobacco, approximately 12,000lb. of this crude tobacco were sold on the Iringa market. A mission school includes tobacco culture in its curriculum, but as there are diverse opportunities for the native to make a good livelihood in the Iringa area, nothing is done departmentally to encourage cultivation of fire-cured tobacco by natives, but if assistance is specifically requested this is given without discrimination. Agricultural apprentices are trained at Iheme for the purpose of meeting European plantation requirements.

CENTRAL PROVINCE.

As stated in the last annual report, this department maintains no staff in the Central Province. There is a heavy density of population for such a semi-arid country; the main crops are millets and groundnuts. In order to assist in the maintenance of the fly barriers which have been cut to arrest the spread of tsetse, cotton will be tried in certain selected areas, but there is no intention to spread its cultivation to the extent that the present barrier, against the spread of pests and disease between the Lake Province and the cotton areas east of the Rift Wall, is broken.

Experimental Work.

Considerable progress has been made in regard to research in its application to the main industries of the Territory. In view of the increase in crop production achieved over a period of low prices it may seem strange that research facilities which were not provided during the period of high prices, when the several industries could better afford them, have been established in the last year or two of the economic depression. But during the post-war years the planting industry enjoyed a margin of profit so large that little attention was paid to efficiency in production. Whereas in the recent period of low prices

agricultural industry has been forced to cut costs and there has been a greater incentive to efficiency. Sisal and coffee planters, a year or two ago, willingly agreed to the impost of a tax on their products to finance experimental and research stations; this, together with generous assistance from the Colonial Development Fund and the Empire Cotton Growing Corporation, has resulted in the establishment of experimental stations for sisal and coffee and for extended work with cotton.

Close touch is maintained with the East African Agricultural Research Station and officers in charge of experimental stations are especially indebted to the advice and assistance accorded them by the Amani research workers.

Reports from the several experimental stations will be found in Annexures IV to X; a summary of their activities is given below :—

NORTHERN PROVINCE.

Coffee Research and Experimental Station, Lyamungu.—The authorized programme of buildings is now practically complete. The installation of power, gas and water was not completed until July; up to this date, therefore, the work of the technical officers was considerably handicapped. Steady progress has been made during the year in the development of the lay-out of the site as an experimental area.

The Entomologist and Plant Pathologist are attached to the Coffee Research Station; the Entomologist being temporarily stationed at Nyakato, Bukoba district, for special investigations of the mealy-bug and other coffee insect problems.

Individual tree records of cherry yield have been completed for the second season on some ten thousand trees situated throughout the Northern Province and the Mbosi area of the Mbeya district. From these recorded trees "mother" trees will be selected for future propagation. The effect of physiological factors, e.g. soil, spacing, shade, etc., were studied by means of sand cultures in a preliminary way. With the knowledge gained, work on a larger scale will begin immediately. The technique of vegetative propagation of coffee has been considerably advanced and in 1936 it is intended to lay out quantitative experiments with vegetative propagation. Full investigations on *Hemileia* are being carried out by the Plant Pathologist and several field experiments have been laid down.

The reports of the Entomologist, Plant Pathologist and Chemist are included under that of the Chief Scientific Officer, which is given as Annexure IV.

TANGA PROVINCE.

The Sisal Experimental Station, Mlingano.—This station, started towards the end of 1934, is now nearing completion. The construction of the houses, office and laboratory was carried out in a most satisfactory manner by the Public Works Department by the end of the year. The estate of 1,087 acres was covered by a dense forest of rubber when purchased; clearing operations have therefore been the chief work and 130 acres have been completed and 770 acres opened up. A suitable area has been prepared for experimentation and the first series will be laid down in 1936. Seven hectares of blue sisal, *Agave amaniensis*, were planted in March. A collection of different species of Agaves has been started. A manurial trial (in connection with banding disease) and a spacing trial have been laid down on outside estates. Investigations are also being carried out on the sisal weevil.

EASTERN PROVINCE.

Morogoro Experimental Station.—This station deals with cotton, sorghums, maize, citrus, animal husbandry and mixed farming generally. Nursery work is an important service of the farm. Cotton work was handicapped during the past season on account of the poor viability of the seed (due to disease) from the 1934 crop. Cotton selection work continues. Various U/4 strains from Barberton and Nyasaland were tried out and some very interesting and hopeful results obtained; some of the imported strains gave yields of seed-cotton two and three times greater than the local district cotton. The ginning percentage of these new strains is three to four per cent higher than the local cotton. Twenty-eight bales of the Barberton strains have been sent to England for commercial report.

The dairy herd is now completely stall-fed and some interesting and valuable figures have been compiled, showing the possibilities to the Territory of this system of dairying. During the seven months in which the cows were stall-fed, the average daily milk yield per cow has increased by one and a half pounds. Forty-three head of stock are maintained on fifteen acres of land, four acres being irrigated; edible canna, rhodes grass and elephant grass are the main stock feeds. The risk of tsetse fly is reduced to the minimum.

The technique of compost making has been worked out, using available crop waste and the manure from the stall-fed animals. Following this work a local cotton ginnery intends to convert its surplus seed into compost for the use of cotton growers.

The Kingolwira Extension and Settlement Farm mentioned in Section I has been developed considerably. The two houses, stores and office are now complete, a pump and water line have been installed to provide water available for the station and families settling thereon. Peasant holdings have been started, and cattle cultivation on the farm has begun. Tsetse fly incidence on the property has been greatly reduced. Arrangements for a prison camp on the farm were completed by the end of the year.

Approximately a hundred acres were planted with the imported cotton strains from Barberton; in spite of the April drought some of these strains did extremely well. An experimental area has been prepared for work in 1936. Good crops of maize and sorghum were also grown for the labour employed.

Mpanganya Experimental Station, Rufiji District.—As this station was only reopened towards the end of 1934, development has been the chief work during the past season. The experimental work was mainly confined to cotton and rice and considerable selective work was undertaken with these two crops. Good progress has been made and a full experimental programme has been arranged for 1936.

LAKE PROVINCE.

Lubaga Experimental Station, Shinyanga District.—This station serves the semi-arid hinterland, and the U/4/4/2 zone, of the Lake Province. A considerable amount of capital work has been carried out during the year in the form of new buildings and the reorganization of the farm. This year's experiments with U/4/4/2 have demonstrated that the growing of this cotton in the Shinyanga, northern Nzega and Kahama districts is justified. Several new U/4 strains from Barberton were tried which have given promising results. Simple rotational experiments have been started, in view of the impoverished soils of this area this work is especially called for. A native authority seed and

multiplication farm adjoins the station, this is also used as a training centre, a demonstrational farm and ploughing school; peasant holdings have also been established. The seed farm earned revenue to the extent of over £250.

Ukiriguru Experimental Station, Mwanza District.—This important mixed farming station serves the thickly populated lake shore area of the Mwanza district. The cotton work during the year included trials of selected strains, mass selected against ordinary district cotton and U/4/4/2 against Uganda Upland. Several of the selections of previous years showed further promise. The classification of sorghums has reached a point at which selection within varieties can be carried out. Other experiments included trials of groundnuts, millets, maize, rice and the residual and direct value of cattle manure and green manuring. The subject of stock feeding is of great importance in the Lake Province and the combination of stock and crops in a mixed farming system has received careful attention. Further new native holdings were started and the owners have done well. The chiefs and their people are showing great interest in the work of this small but important station.

IRINGA PROVINCE.

Iheme Experimental Station, Iringa District.—The aims of this station are primarily tobacco experimentation, mixed farming and fruit culture; gradual development as a general training centre is also intended. Three new fire-curing barns have been built. Pure-line selection of Heavy Western tobacco has been continued; this variety is, however, particularly susceptible to "red rust" and it appears that it must sooner or later be discarded; to this end several varieties have been introduced from the United States of America. Afforestation, anti-soil erosion, and plant introduction and distribution are important functions of this station.

Agricultural Education.

The Agricultural Training Centre, Bukoba district, started in 1933, has had its domestic difficulties during the year, mainly due to the failure of the pupils, who have finished the course, to obtain salaried employment. From the very beginning of the venture it has been stressed that the object has been to train youths to be better peasant farmers on their own account, but the majority of the younger generation of Bukoba does not regard work on the land with much favour. However, the policy will be adhered to and rather than change to a type of education "within four walls" it would be better to close the school altogether. The agricultural classes in the classroom and field are taken by agricultural officers; elementary teaching in reading, writing, geography, arithmetic and so on is carried out by Africans seconded from the Education Department and is given an agricultural bias wherever possible. The course of training lays emphasis on the importance of mixed farming, the proper conservation and use of manure and vegetable refuse, and the general care of coffee, all essential to good farming in Bukoba.

Classes are held both at the Ukiriguru and Lubaga experimental stations for the training of African agricultural instructors, market supervisors and produce graders.

It has been amply demonstrated that the improvement of the economic conditions of the mass of peasant producers should precede the extension of educational facilities, in order not only to accord the necessary financial provision for the latter, but also to stimulate the peasant to a desire for education in its best practical form. A start has been made in the Lake Province to

develop centres of local culture, embracing all aspects of the rural economy of a planned peasant-holding settlement. Elementary education is given to adults as well as juveniles, the important point being that neither should be taken away from their homes and the land; a workshop is to be provided and instruction in arts and crafts necessary to home life and animal husbandry. The school pupils, young and old, and other peasant holders will have the assistance of the trained artisans of the settlement centre to assist them to improve their own homesteads in brick making and building, carpentry and iron-work. Veterinary, medical and forestry activities will play an important part in the centre; hide-drying, ghee dairies and co-operative effort and so on will all be advanced, so that education shall be applied in its widest sense. A start has been made at Lubaga and, at Ukiriguru, the medical authorities are closely allied to the work in relation to sanitation and hygiene.

Speaking of the original peasant-holders at Ukiriguru, Mr. Thornton, Agricultural Officer, reports that they are in far better mental and physical condition due to the better and more varied food. (After the first season they consumed the milk instead of selling it as they did in the beginning.) Also they asked to apply part of their savings to pay for education for themselves.

A prison farm has been in existence for some years near Tabora and has done good work. At the prison training centre at Kingolwira it is intended not only to give agricultural training, but to enable the most promising of the long-term prisoners to develop a peasant-holding so that they will have a homestead, at least partly developed, awaiting their release.

Ploughing schools are maintained at Iheme and Lubaga.

Native agricultural shows were held throughout the Lake Province and at Kilosa in the Eastern Province, and again proved their educative value. It is, however, important to see that they do not deteriorate into mere social and sporting events.

A feature of the Kilosa show was a combined trade and crop production exhibit with the idea of demonstrating the amount of exportable and other crops necessary to purchase certain useful objects. The spending power of the native has greatly increased in the past year and education is required to teach them to spend wisely; commercial bodies are capable of giving valuable assistance in this important matter.

Soil Erosion.

The evils of soil erosion are consistently brought to the eyes of the people, and education and demonstration of the measures to be taken to protect the fertility of cultivated lands from wash have been intensified throughout most of the Territory. For the aims and methods generally followed throughout the department to ameliorate the conditions of soil erosion on cultivated mountain slopes, reference should be made to the report of Mr. R. M. Davies, Senior Agricultural Officer, which will be found in Annexure I, paragraphs 22 to 26. In the Lake Province and other areas the problem of over-stocking is closely bound to that of soil erosion and the solution is held to be mainly in the extension of peasant-holdings and stall-feeding of cattle. The high standard of production in the Lake Province will result in a dangerous position in regard to sheet-erosion unless careful guidance is given.

With the assistance of the agricultural staff in the Northern Province, an instructional film dealing with the soil was prepared by the Bantu Education Kinema Experiment for display to African audiences.

Under the authority of the East African Governors' Conference, the first three issues of the *East African Agricultural Journal* were made during the year. The Director of the East African Agricultural Research Station, the editor of the journal, is assisted by an editorial board consisting of the Directors of Agriculture for Kenya, Tanganyika, Uganda and Zanzibar.

The following pamphlets and leaflets were published by the department during 1935 :—

Pamphlet No. 14 : "Programme of an Agronomic Investigation of Sisal," by G. W. Lock, Agricultural Officer.

Pamphlet No. 15 : "The Objects and Scope of Coffee Research and Experimental Stations," by S. M. Gilbert, Chief Scientific Officer.

Mycological Circular No. 4 : "Ugonjwa wa Tumbako (Wildfire) jinsi ya Maradhi na namna ya Kuuzuia kwake," by G. B. Wallace, Plant Pathologist.

Other leaflets prepared during the year are as follows :—

"Pink Boll-Worm of Cotton," by A. H. Ritchie, Entomologist.

"Note on a newly determined Tobacco insect," by A. H. Ritchie, Entomologist.

"Tobacco Culture," by C. J. McGregor, Agricultural Officer.

"Notes on Citrus Nursery practice," by J. C. Eyre, Agricultural Officer.

"The destruction of baboons," by C. J. M. King, Agricultural Officer.

"The Sisal Weevil," by W. V. Harris, Assistant Entomologist.

"Seed Colour of Sesame," by R. B. Allnutt, Agricultural Officer.

"Ramie, Preparation of Ribbons," by N. M. Wight, Agricultural Officer.

"Note on the Picking and Preparation of Coffee," by B. E. Eustace, Agricultural Assistant.

"Cotton Capsid," by A. H. Ritchie, Entomologist.

"Ramie Grass," by N. M. Wight, Agricultural Officer.

Articles sent to the editor of the *East African Agricultural Journal* for publishing during the year 1935 are as follows :—

"Measures against Soil Erosion in Tanganyika Territory," by E. Harrison, C.M.G., Director of Agriculture, Tanganyika Territory.

"Cotton Selection and Rotation of Supply of Improved Cotton Seed," by N. V. Rounce, Agricultural Officer.

"Notes on Turkish Tobacco," by C. J. McGregor, Agricultural Officer.

"Tea Cultivation in the Southern Highlands of Tanganyika," by R. M. Davies, Acting Senior Agricultural Officer.

"Kiln Drying of Copra," by C. B. Garnett, Agricultural Officer.

"The Cultivation of Sisal," by G. W. Lock, Agricultural Officer.

"Development of the Mlingano Sisal Experimental Station," by G. W. Lock, Agricultural Officer.

"Notes on the Tung Oil Tree," by C. J. McGregor, Agricultural Officer.

"Observations on Coffee under Artificial Shade at Selian Coffee Estate, Arusha, 1931-1935," by D. Sturdy, Agricultural Officer.

"A Parasitic Weed of Sorghums," by N. R. Fuggles-Couchman, Agricultural Officer.

"Armillaria Root Rot in East Africa," by G. B. Wallace, Plant Pathologist.

"Preliminary Notes on the Soil Erosion Demonstration at the Coffee Research Station, Lyamungu, Moshi," by the Staff.

Other articles were as follows :—

"Cotton in Tanganyika Territory," by E. Harrison, C.M.G., Director of Agriculture, for the *Empire Cotton Growing Review*.

"Native Production of Coffee on Kilimanjaro," by A. J. Wakefield, Deputy Director of Agriculture, for the *Empire Journal of Experimental Agriculture*.

SECTION III.—Finance.

The financial provision for the period 1st January to 31st December, 1935, together with the estimated expenditure, is given below. Comparisons between individual headings under this and a similar table given as Appendix V to the report for 1934, would be misleading owing to changes in the headings under which certain charges have been placed. Attention is also drawn to the omission this year of contributions to agricultural activities outside the department, such as the East African Agricultural Research Station and Imperial Bureaux, etc. ; these no longer appear under this department's head in the territorial accounts.

Excluding the item Special Expenditure, the total vote for the service of the department during 1935 was increased by £8,481 over 1934. £4,863 of this was accounted for under "Personal Emoluments" and £3,618 under "Other Charges."

The generous recurrent grant made in 1934 by the Empire Cotton Growing Corporation was continued and £4,740 of this was expended in 1935. Nearly £4,000 of the Corporation's capital grant of £6,850 was also utilized in 1935.

The British Cotton Growing Association gave financial aid to further the department's work with cotton and paid the salaries of two ginnery inspectors who were appointed during the year.

The substantial assistance given by the above bodies is gratefully acknowledged.

Contributions from the Colonial Development Fund amounted to £6,110 during 1935, being £5,000 for the coffee research station and £1,110 for the sisal research station. In addition, a grant of £900 was made by the Colonial Development Fund to the Board of Trustees for sisal research in England.

Under "Special Expenditure," the heavy expenditure on "anti-locust measures" during the past few years shows a welcome decrease of £4,590 as compared with last year.

The following are the estimates of direct revenue secured by the department in 1935 as compared with those received during 1934 :—

	1934 £		1935 £
General sales	600	...	250
Bukoba coffee grading fees ...	2,628	...	2,900
Sisal Tax	2,464	...	4,245
Coffee Tax	1,600	...	2,563
Cotton Tax	3,100	...	5,600
Totals ...	£10,392	...	£15,558

The sisal tax fund is designed to meet the debt charges and a part of the recurrent costs of the sisal experimental station, also to finance the sisal board and the Tanganyika Sisal Growers' Association and such overseas research in new uses for sisal as may be desired by the Tanganyika Sisal Board in collaboration with the Kenya Board. A balance of £1,700 was available from

1934 and in 1935 expenditure from the sisal tax funds amounted to £4,353, of which the sum of £2,873 was expended on the expenses of the Tanganyika Sisal Growers' Association and the cost of overseas research.

The coffee tax fund was intended to meet the debt charges of approximately £1,600 on the capital outlay of the coffee research station. During the year a subvention of £280 was made to meet the expenses of the newly formed Tanganyika Coffee Growers' Association. The accumulated balances in the coffee tax account at the end of the year was in the neighbourhood of £1,700, and it was decided to reduce the tax by half for the year 1936.

Revenue from the cotton tax is utilized in meeting a part of the departmental service given to the cotton industry, also the costs of special seed distribution, the temporary and permanent employment of supervisors for the planting and marketing of cotton, for special development work at settlement centres where cotton is to be established and for roads in new cotton areas.

A list of European staff as on 31st December, 1935, is given as Appendix I.

The details of the provision and expenditure referred to above are given in the following table :—

	Provision for the period 1/1/35 to 31/12/35 £		Estimated Expenditure for the period 1/1/35 to 31/12/35 £
Personal Emoluments:—			
Administrative	6,291	...	5,830
Scientific Staff	4,140	...	4,132
Field and Experimental Farm Staff	34,326	...	32,676
TOTAL Personal Emoluments ...	£44,757	...	£42,638
Other Charges:—			
Travelling (including Railway Fares and Freight, Travelling and Transport Allowances, Transport and Passages)	10,001	...	8,524
Upkeep of Experiment Stations and Plantations	8,501	...	7,716
Upkeep of Nyakato Agricultural Training Centre	750	...	723
Upkeep of Ploughing Schools ...	200	...	187
Purchase of Seeds	155	...	138
Plant Sanitation	95	...	67
Purchase of Tools and Scientific Equipment	275	...	240
Expenditure on Cotton Tax Services	3,100	...	2,904
Agricultural Development, Special Services	200	...	117
General Expenditure (including Books of Reference, Tents and Camp Equipment, Uniforms for African Instructors, Typewriters, Upkeep of Museum, Agricultural Shows, Stationery, Messengers, Bicycles and Contingencies) ...	694	...	564
TOTAL Other Charges ...	£23,971	...	£21,180

	Provision for the period 1/1/35 to 31/12/35		Estimated Expenditure for the period 1/1/35 to 31/12/35
Special Expenditure:—	£		£
Anti-locust Measures	2,000	...	1,060
Empire Cotton Growing Corporation—Capital Grant	5,793	...	3,964
Sisal Experiment Station—Capital Expenditure (excluding P.W.D. work)	740	...	684
TOTAL Special Expenditure ...	£8,533	...	£5,708

SECTION IV.—LEGISLATIVE CHANGES DURING 1935 AS AFFECTING AGRICULTURE.

I. *Cotton.*—(i) Owing to the presence of pink boll-worm in the Western Province, regulations were enacted giving the Director of Agriculture authority to order the destruction of all kidney cotton in this province (except in the Ufipa district).

(ii) The Eastern and Central Provinces and the districts of Tabora and Kigoma were declared to be cotton quarantine areas. This order brings up to date the previous enactment to prevent the spread of the pink boll-worm to areas not at present infested with this pest.

(iii) A rule was enacted prohibiting the removal of any unginned cotton out of the Mbulu district.

(iv) Under the Cotton (Fees) Rules, the usual schedule of the fees payable for ginnery licences and for cotton buying licences were published.

(v) In pursuance of rule 37B of the Cotton (Amendment) Rules, described above, the maximum ginning and baling of cotton fee was fixed at eighteen cents per kilogram of lint in metric areas and eight cents per pound in avoirdupois areas.

II. *Tea.*—The Tea Ordinance, 1934, was amended to permit the exportation of tea seed from this Territory to Kenya Colony and to Uganda. This amendment enables these two countries which contribute to the maintenance of the East African Agricultural Research Station at Amani to obtain tea seed produced there.

III. *Sisal.*—(i) In order to prevent the spread of the sisal weevil from the Tanga Province to other areas not at present infested with this pest, regulations prohibiting the removal of any sisal planting material, except under permission by the Director of Agriculture, were enacted.

(ii) The export of plant material of blue sisal, *Agave amaniensis*, was prohibited under the Customs Ordinance.

IV. *Rice.*—The removal of any rice from the Kilosa district to the Kiberege division of the Mahenge district is now prohibited. This order was made to prevent the spread of a newly found "smut" in the Kilosa district.

V. *Coffee.*—(i) Under the Coffee (Tax) Ordinance, 1933, a tax of one shilling per ton was provided for on all coffee grown in the Bukoba and Biharamulo districts of the Lake Province; the order takes effect as from the 1st January, 1936. Arrangements were also made to apply the tax to the southern highlands, so that all the main coffee growing areas now contribute to the maintenance of the coffee research station.

(ii) Under the Produce Export Ordinance, 1935, rules were provided to make compulsory the grading of all coffee exported from the port of Bukoba. These rules will come into force in 1936 and have received the approval of the trade.

VI. *Beeswax.*—Under the Produce Export Ordinance, 1929, rules regarding the export of beeswax were published for consideration by the trade. Under these rules all beeswax intended for export which is produced in the Eastern, Central, Iringa, Western and Lake Provinces must be exported through Dar es Salaam; beeswax produced in the Southern Province can only be exported through either Kilwa, Lindi or Mikindani and beeswax from the Northern and Tanga Provinces can only be exported through Tanga. The wax must be exported under a mark indicating the port of export. Also, no beeswax can be exported from the Territory except in pieces not exceeding eight ounces in weight. It is intended to apply the rules early in 1936. An order was also framed to declare that the importation of beeswax, except in transit, into the Territory is prohibited.

Conclusion.

It is desired to express appreciation of the loyal services rendered by all members of the department during the year, and to accord thanks for the enthusiastic assistance rendered by officers of the provincial administration and other departments. I would also like to record the pleasure which was given to the staff when the Director, Mr. E. Harrison, was awarded the C.M.G. for services rendered to this Territory.

A. J. Wakefield,
Acting Director of Agriculture

Morogoro,
14th February, 1936.

Annexure I

ANNUAL REVIEW OF THE NORTH-EASTERN CIRCLE.

Northern and Tanga Provinces.

1. *Staff.*—In last year's report reference was made to the difficulties occasioned through there not being at all times a sufficiency of staff to meet the requirements of every district. This was due to movements and transfers which had to be made. This year, however, the circle has been more fortunate in not having to contend with the same difficulty; there has been a normal complement of officers and these have been throughout the greater part of the year in charge of districts unchanged. Even so, with the immense possibilities that there are for progress and development the staff is constantly faced with the problem of how to keep pace with the increasing demands for their assistance.

2. Also as each year passes it is noticeable how much more diverse the agriculture is becoming. Topography, climate, soil and economic conditions, to mention some of the factors, are so varied as to make it possible to grow almost any agricultural produce within this circle. This spread of interests although a very welcome step in the right direction does mean that the sphere of our activities is constantly being enlarged and calls on service are becoming greater.

3. For the first time, from the end of March, the Usambara and Pare districts have been separated and the latter district has been given the full-time attention of an agricultural assistant.

4. There has been a slight increase of African instructors in those areas which have been working with a skeleton staff owing to the depression. It is hoped that further increases can be made with the assistance of the native authorities in order to be able to give attention particularly to soil erosion over a still wider field and also to prepare for new areas of production.

5. The arrangement has been continued whereby we have given assistance to planters and to the development of native agriculture, particularly cotton, in the Taveta area of Kenya Colony. The department in Kenya is kept informed of the work being done.

6. *Weather and Rainfall.*—After two years of very unsatisfactory rainfall, of which 1933 may be classed as a drought year, it is pleasing to be able to say that there have been good rains during the main season this year. Generally speaking, the year has been an excellent one from the point of view of crop yields in those areas depending chiefly on the long rains. Areas dependent on the short rains did not fare so well. At the end of 1934 these rains were scanty and the area most affected was the northern strip of the Usambaras where food crops during the present year were short. Good rains have fallen during November and December so that this area should harvest good crops later on.

7. On the coastal belt the highest figure for fifteen years has been recorded. Up-country, the Arusha and Moshi districts received a plentiful supply and

the only area which perhaps did not have an average amount of rain was that below the Rift Wall in the Mbulu district.

8. Despite the general excellence of the rainy season it had to have its vagaries. The first rain of any consequence arrived earlier than usual in the last week of February and caught people unaware. Good falls continued well into March when there was a sudden break followed by a dry April. After this there was continuation of rain late into September. Briefly, then, a good start was marred by a break and the continuance of rain rather too late into the cropping season. The vagaries in the distribution noted above caused some anxiety amongst maize and cotton growers, many cotton areas had to be replanted more than once and the lack of sunshine must have influenced the maturing crops.

9. During the cold month of the year temperatures up-country have been some degrees lower than usual and in one area in the Arusha district caused severe "scorch" and loss of a number of coffee trees. The rains have favoured a very heavy coffee crop particularly in the lower and main belts on Kilimanjaro and Meru. Cold weather coupled with a prolonged rainy season delayed the ripening of the coffee crop by at least a month. The humid conditions were favourable to the attack and spread of *hemileia*, the incidence of which was heavier than usual.

10. *General Remarks on Crop Production.*—Producers generally have had a very difficult time during the last few years. There have been drought, locusts and a low price for commodities and it is extremely fortunate for the prosperity of the area that it is not dependent on one crop. Sisal and coffee, the two principal export industries, were not at the mercy of drought and locusts to the same extent as some native areas growing their food crops and cotton. Sisal and coffee production have been well maintained this year, coffee constitutes a record but whereas the price of sisal, after a series of bad years, has picked up considerably, the opposite is the present position with regard to coffee. Coffee kept up well during the depression but the producers are now going through a very critical period. The favourable climatic conditions this year have put the food producing areas on their feet, particularly Handeni and Mbugwe where famine had occurred previously.

11. It can be appreciated, however, that much valuable experience has been gained during this period of adverse conditions because of there being so many different classes of producers affected. The problem of finding ways and means of adapting farming practices to meet these uncertain circumstances is by no means easy; particularly is this the case regarding the European farmer. In the economy of the native producer the lesson has been learned that all areas must carry adequate supplies of cassava and sweet potatoes as protection against drought and locusts. In this respect the position is sound as a result of the special efforts which have had to be made to overcome the indifference of the average native cultivator. The good rains which have fallen this year allowed plantings in all areas to become safely established. Vigilance has to be kept to make sure that present efforts will not be allowed to lapse but will be maintained in the future.

12. The coffee crop in all areas has been exceptionally heavy, the short rains at the end of 1934 favoured a good flowering and setting of crop. Early in the season it was patent that in the Moshi and Arusha districts overbearing was likely to occur. Added to this the rains began sooner than usual and humid conditions prevailed late into the year with the result that control of *hemileia*

was particularly difficult. For this reason, too, the crop was late in ripening, amounting in the upper belt on Kilimanjaro to at least a month. The general consensus of opinion is that the bean is better sized than during the past few seasons but inclined to be irregular. There is no doubt that a year such as the present one throws into relief the merit or otherwise of individual plantations or plots, indicating clearly where there is any weakness. If the value of good farming practice is so conspicuous, so also are the insidious troubles which are the outcome of faulty practice leading to low resistance on the part of the trees and which can only result in loss to the owner. The sequel to this, to which reference is made later, is that as time goes on the real causes of the troubles are entirely lost sight of because the weakening tree is a prey to other disturbances merely secondary. These secondary disturbances are now being given undue prominence and attention as though they were the real causes. The dangers of accepting palliative treatment as sound are obvious, especially at a time when planters are attempting desperately to make both ends meet.

13. The production and export of sisal and twine shows an increase over last year. This is as a result of past development bringing additional acreages into bearing and also because of heavy cutting induced during the second half of the year when a substantial rise in the export price occurred. For the first time sisal was exported from the Arusha district where cutting commenced in October on one estate. Development is taking place in the Moshi district and no doubt the recovery in the market will stimulate development in the main sisal area of the Tanga Province. Production of sisal is closely associated and influenced by the labour supplies obtainable.

14. Production of non-native maize on the lower slopes of Kilimanjaro shows further increase. The benefits gained by growers through the good services rendered them by the Kenya Farmers' Association last year stimulated those already in the field to increase their acreage and attracted others to come in. It is estimated that four thousand tons will be available for export. On account of the crops in Argentine and the United States of America being considerably in excess of last year's yield and the world production of maize approximately fifty per cent over the previous season, there has been a sharp fall in the market price for export maize. Despite the high comparative yields obtained in the Moshi district, amounting to twenty bags per acre on the good farms, growers are finding it unremunerative to produce for export with prices at the present low level. Considerable surplus stocks of native-grown maize were also available from all districts. So low has the price fallen for native maize that there is little encouragement for him to grow more than his maintenance requirements and there is no doubt that wherever he can do so he will turn to cotton as a crop giving him a better return for his efforts.

15. It is anticipated that there will be a five-fold increase in the native cotton crop over last year. This is accounted for mainly by the better season, and partly to an increase in the number of growers in the Luengera valley and Mbugwe area. Previous seasons had been so disheartening that growers had lost a good deal of their enthusiasm for cotton. This was not unexpected and reacted against the crop this year with the result that far too much of it was late planted. Despite this, fair to good yields were obtained and those who planted cotton are well satisfied with the reward for their labours. Such satisfaction is a much wanted spur towards increased individual enterprise and encouragement to others, not only to grow cotton, but to grow it well. The bulk of the area under this crop is extremely fertile and capable of averaging

six hundred pounds of seed-cotton per acre under normal conditions. Unfortunately a great deal of land suitable for cotton production is very sparsely populated, the Luengera valley and the low-lying tract in the vicinity of Moshi have scarcely been touched. In respect of the latter piece of country the Agricultural Officer, Moshi, reports that the highest yield met with was that of a Sukuma native in Kahe who cultivated over five acres of cotton, his yield is estimated to be over one thousand pounds of seed cotton per acre, rainfall was supplemented by one irrigation and the only labour he employed was at picking time. Apart from this he had more than the usual variety of crops on his holding, many of which are grown out of season with irrigation. Other considerations are that the special value of these tracts is that they are not erodable.

16. Non-native cotton production has also shown an increase on account of the enterprise of a group of planters in the Mbugwe area of Mbulu district where there exists a stretch of fertile land under the Rift Wall. This was their first year and despite considerable initial clearing expenses they are of the opinion that this is a profitable crop on a plantation scale.

17. Development in sugar planting has taken place during the year on an estate near Moshi. One thousand acres are now under this crop. A factory is in course of erection and is expected to operate early in 1936 for the production of "96" sugar for export purposes.

18. Wheat growers in the Oldonyo Sambu area received a free issue from Government of wheat seed. So serious had the lack of rain been for the previous two seasons that the farmers had a complete failure of their crops. Yields obtained were low, not altogether because the rains were only moderately good but because the oxen for ploughing had to be given time to pick up condition before they could work the land, which meant a serious delay in planting.

19. Amongst other crops there has been a notable increase in the acreage under rice which is partly attributed to the bountiful rainfall giving a sufficiency of water for the crop in places which can only be utilized in especially favourable years. Attention has been given to the rice growing area of the Pare district where the peasants were inclined to indulge in wasteful methods of using the land. A good increase in production has been obtained from the area and a further significant increase may be expected in the future. In general it may be said that the bulk of the native population live up in the hills. It requires more than ordinary attraction to make these people regard the plains as a favourable place either to cultivate export crops for established and unlimited markets or to enter into estate employment such as sisal. As matters now stand much of the natural wealth of the country is on the plains and the population is up on the hills where they grow crops which have a restricted local market.

20. There has been a big fall in the export of copra. In the first place palms had not recovered from the effects of drought and defoliation by locusts; not only were numbers killed outright but yields were seriously affected. Other minor contributing causes were an increase in the sale of fresh nuts locally and to Zanzibar and also consumption of copra by the local soap works. Kapok and citrus trees similarly suffered from drought and locusts and both gave poor crops. Recovery has taken place during the year which has promoted a heavy flowering and promise of good crops in 1936. In the Korogwe area half the acreage under kapok is not yet bearing whilst planting is still continu-

ing and a considerable increase in production may be anticipated in a few years' time.

21. The Muheza orange crop has been the poorest for many years. There has been little extension of planting amongst native growers who own most of the trees. Efforts are being made to stimulate the owners to take more care of their producing trees, to the harvesting of ripe fruit and to interest them in planting selected and budded trees which are being made available for them. So far very little interest in citrus is being shown by planters. A commencement has been made, however, on one plantation to realize on old established Seville orange trees by extracting equellor oil. This is a new export and promises to be a remunerative line; costs of production, transport and preparation are all low. The possibilities of erecting a distilling plant for neroli and petit-grain are also being explored.

22. *Soil Erosion.*—If reference is made to this subject in past annual reports it can be seen how much attention has been given to it by means of continuous propaganda and demonstration. Particularly has this been the case on Kilimanjaro in the Moshi district where for many reasons it has been possible to make a more intensive and sustained study of the problem over some years and covering a wide field. As a result of this work it is clear that the experimental stage of it was passed. As evidence of this not only were there numerous demonstrations on terracing, contour hedges and contour bunding to be seen everywhere which had been in existence long enough to prove their efficiency but also judging from the attitude towards them by very many of the native cultivators themselves. Communal efforts on anti-erosion work and reafforestation have been successfully carried through so that generally speaking we have received willing co-operation from large numbers of natives.

23. Previously any legislation dealing with erosion measures was confined to coffee plots and to the prohibition of cultivating or clearing of steep valley sides. During the present year legislation was carried a step further to cover all cultivations and also by making necessary amendments to the unsatisfactory riverside rules. If action was necessary to control erosion in coffee plots, it was urgently needed on the arable fields of maize and other crops as well, particularly so now since pressure of population is driving the people downwards into areas capable of being devastated by erosion in a short period. This is an extremely important step forward and could not have been carried out had it not been that the chiefs and people themselves found the proposals to be acceptable to them. Such an attitude is a very great tribute to those officers and instructors of the department who have done such a tremendous amount of educational work on these lines and throughout have succeeded in carrying the native cultivator with them. It is a testimony which should dispel any doubt that because of legislation they will fail to continue to do so. It is even more necessary now that the educational side should not be relaxed if our aims are to continue to be successful. In this work as well as in many other activities it would be difficult to over-estimate the value of an organization such as the Kilimanjaro Native Co-operative Union. The very closest co-operation continues to exist between the union and the department and we receive every assistance from their staff. Meetings are frequently held between the manager and *wakili* of the Kilimanjaro Native Co-operative Union and the staff of the department for the discussion of field problems and programmes of work. Their monthly publication to members is a valuable medium for the dissemination of agricultural information. Further we receive

the active support of the chairman, committees and field staff of the local societies. Close association with such an organization provides conditions which are exceptionally favourable for further progress.

24. As has been indicated anti-erosion methods have already been adopted by the natives in most places, the principles are well understood and the education work accomplished excellent. The new rules framed to provide for protection measures on all occupied land are simple to understand and to appreciate, and give the necessary authority to the native authorities working with the Agricultural Department to enable them to carry on successfully the work already undertaken. Separate rules were considered with a view to covering reafforestation works and major anti-erosion schemes beyond the capacity of the individual to carry out. The old riverside rules were suitably amended to accord more with the lie of the land. In amending these rules it was first desired to prohibit the grazing of livestock in the controlled riverside areas but when the point was put to the people unanimity could not be reached. To compromise it was left to the individual chiefs and their elders that if they considered that in the interests of the people and without hardship grazing should be prohibited in prescribed areas they should, after approval by the administrative officer, issue the necessary order. Reafforestation to safeguard slopes considered too steep for cultivation has been undertaken. This work is carried out communally whenever the time can be spared. It is noticeable how variable is the response to this type of activity, depending upon whether or not the chief is keenly interested in the welfare of his area. On eastern Kilimanjaro this year fifty-four thousand seedlings were put out.

25. Connected with the subject of erosion there was published, early in the year, the report by Dr. Teale and Mr. Gillman on their "Investigation of the proper control of water and the reorganization of Water Boards in the Northern Province of Tanganyika Territory." Such a presentation of the subject with all the interrelationships involved was of the greatest value by giving a clear picture of a complex set of problems and prominence to the series of dangers against which urgent protective measures are necessary. The authors stress the vital importance of the time factor, recognizing that educational and persuasive methods are undoubtedly too slow, and press for, as unavoidable, "benevolent but firm compulsion in order to guide people into efforts designed to save them from themselves." In this latter respect, as has been stated above, further new legislation has been introduced during the year but covering the activities of native cultivators only. Although the non-native farmer should be alive to the situation and dangers his reaction cannot in general be said to be satisfactory, practices of careless irrigation and lack of protective measures being too common. It is equally essential that they, too, should participate in the legislation.

26. Elsewhere in other districts rules are in force to cover certain aspects of the subject but owing to lack of staff it has not been possible to make quicker progress. Arrangements have already been made, however, to recruit instructor staff and thereby extend the demonstration work previously carried out to cover a much wider field. It is necessary that the chiefs and the more enlightened individuals be assured of the results of such efforts to get the greatest possible effect from legislative measures. Their co-operation is essential. Finally, as a valuable aid to disseminating information on the subject of erosion, the director of the Bantu Education Kinema Experiment visited Moshi and prepared an instructional film dealing with the "soil" suitable

for display to native audiences in general in East Africa. Briefly the film depicted the clearing of virgin land showing how it could be ruined by unsound methods of cultivation and demonstrating ways and means of preserving the soil against erosion and of keeping it in sufficiently good condition to enable it to be drawn upon for food supplies by crops without deteriorating.

27. *Marketing.*—At no time have producers been more alive to the necessity of forming themselves into crop organizations than at present. They have felt that it is only in this way that the best interests and welfare of the industries can be promoted. In general terms their object is to improve the methods of producing, preparing and marketing the crop. Considerable progress has been made during the year along these lines. There are a number of these crop organizations, some of them of long standing and experience, others quite new. They differ amongst themselves as regards their actual activities towards marketing problems.

28. *Sisal.*—The welfare of the sisal industry is covered by the activities of the Tanganyika Sisal Growers' Association together with the Sisal Board. The association has been in existence for some years. Of special importance this year may be mentioned the commencement of research overseas, particularly towards the development of new uses for sisal and the utilization of waste products.

29. *Coffee.*—The Tanganyika Coffee Growers' Association came into being in July of this year and is developing on lines similar to the sisal association and keeping in close touch with the Kenya Coffee Board. Since its inauguration attention has been given to an investigation for the purpose of extending markets. As a result of the direct representation of this association a series of coffee auctions have been held at the close of the year in Mombasa under the auspices of the coffee section of the Mombasa Chamber of Commerce and Agriculture. These have been of some benefit to growers of coffee in the Northern Province. Taking the two December auctions together business in Tanganyika coffees was as follows: of 3,899 bags and 324 packets offered, 3,190 bags and 284 packets were sold. This is a very satisfactory beginning and there is no doubt that wider use of these auctions will be made in the future. It may be mentioned that both the sisal and coffee associations have representation in the commodity section of the British Empire Producers' Organization which organization gives special attention, besides other objects, to the extension of foreign markets for empire products and to the expansion in the proportion and volume of trade within the Empire.

30. The Kilimanjaro Native Co-operative Union is a foundation branch of the Territorial Coffee Association. In itself it specializes primarily in the bulk marketing of its members' coffee after the pooling of the small individual parcels. Despite the fact that to-day it is difficult to dispose of medium class mild coffees the union sold three-quarters of its crop forward. This is the first time that forward sales have been effected and done on the basis of the previous years' samples which points to the confidence of buyers on the standard quality of the coffee produced. Forward sales come under the London Arbitration clause and to date half contracts have been delivered and given satisfaction. These facts go to show that the Kilimanjaro Native Co-operative Union coffee, by able direction, has been put in the favourable position of being on demand instead of on offer at a time when the market for medium coffees has never been more difficult. It seems also proved now that medium types of mild coffees have to-day to be offered in bulk quantities; further it appears best to

sell the bulk ungraded for the grading divides the amount into too many parcels. Of interest in this connection is that the highest prices at the first of the local auctions was obtained by a bulk parcel of Kilimanjaro Native Co-operative Union coffee.

31. *Maize.*—The majority of the non-native maize growers in the Northern Province had formed themselves into a maize growers' association. The big factor influencing the formation of this organization was to group the growers and hold them together so that it might become a unit of the Kenya Farmers' Association, a big organization which specializes in marketing. Affiliation to the Kenya Farmers' Association has been brought about, necessitating the maize growers constituting themselves into a co-operative society. The managing director of the Kenya Farmers' Association visited Moshi on two occasions to meet the committee. Following upon these visits the Kenya Farmers' Association are erecting a railside godown at Moshi and it is expected that during the coming year considerable advances in the working of the new organization will be carried through. It is extremely unfortunate that the time when the maize growers are attempting to organize themselves should coincide with one of the worst years on record as regards price. At such times local speculation on the crop is rife, and this has a very disturbing effect and presents unusual difficulties in the beginning.

32. *Cotton.*—The distribution and marketing of this crop is carefully organized. Cotton buying posts are placed throughout the area and are under the supervision of officers of the department. Prices according to the promulgated scale were paid throughout all districts.

33. *Dairying.*—Dairy farming as an industry is practised in several areas around Meru and Kilimanjaro. Individual dairies and co-operative dairies exist and the bulk of the produce is disposed of locally. Conversations are taking place to explore the possibility of a co-operative creamery which might co-operate with the Kenya Creamery Company.

34. *Produce.*—In the Western Usambaras the marketing of perishable products, such as vegetables and fruits, is undertaken by the Usambara Farmers' Produce Association. The market for such products is limited but could be made greater by the installation of cold storage at the port of Tanga.

35. Particular reference is made in the above paragraphs on marketing to the various crop organizations which exist. This shows how the various units take their place in marketing over a range of products and how larger organizations embrace such units and carry the subject further afield and more effectively.

Boards.

36. *Sisal Board.*—Four meetings of the Board were held at Tanga during the year. This Board advises regarding the funds obtained from the tax on sisal. Subjects which came up for consideration by the Board were sisal utilization research, levy of cess on manufactured sisal exported, the sisal experimental station, grading of sisal and distribution of blue sisal, *Agave amaniensis.*

37. *Coffee Board.*—Early in the year the Coffee Board had prepared a report for a reorganization of the Board and its relations with the coffee industry of Tanganyika; later in the year in May the Board issued a manifesto to the coffee industry of Tanganyika to the effect that it considered that, as an Advisory Board, it had already fulfilled its functions and that any continuation

of it would be unnecessary. The Board recommended to the industry that every effort should be made to implement the recommendations given in the report, that is to say that the industry should organize itself into a Territorial Coffee Growers' Association with branches and ask for the early formation of a Coffee Board to be established under the Ordinance for the advancement and control of the coffee industry. Part of the recommendation has already been implemented. Steps were taken at once to form the Tanganyika Coffee Growers' Association, and the first meeting was held at the Coffee Research Station at Lyamungu in July. At this meeting, which was attended by the chairman of the Kenya Coffee Board, the association was formed and its constitution and rules drawn up. Foundation branch associations, representative of the growers in the Territory, were admitted. A managing committee was appointed to carry on the business of the association and delegates were nominated to attend the Kenya Coffee Conference and also a meeting between representatives of the coffee industries of Kenya, Tanganyika and Uganda held in Nairobi at the end of July. It is hoped that the second part of the recommendations will be implemented by the setting up of the Coffee Board during the coming year.

Crops and Cultivation in Detail.

38. *Sisal.*—The following are the exports over the past four years :—

PROVINCE	1932 Tons	1933 Tons	1934 Tons	1935 Tons
Tanga ...	40,487	45,329	40,614	47,536
Northern ...	1,775	2,490	2,644	2,619
Totals ...	42,262	47,819	43,258	50,155

In addition 1,730 tons of binder twine and cordage were exported in 1935 valued at £44,666.

The bright feature of the year has been the way in which from June values soared upwards. The price of No. 1 at the end of January, 1935, was £15, and at the end of December it stood at £28 10s. in a distinctly firm market. Mexico had by September entirely withdrawn from the market and was out of it at the end of the year. At the same time larger buyers, like the International Harvester Company, were reported to be very short of stocks. Big demands for binder twine for the Canadian and Argentine harvests were to be expected. At the close of the year Russia came into the market to buy. Such an outlook is, to say the least, good, considering that sisal has nearly doubled its value in a year.

39. There has been a steady increase in the acreage under sisal and exports of fibre continue to be greater. In particular development is taking place in the Moshi and Arusha districts as a result of the better present position of the market. In the Tanga Province there are few estates which have not increased their acreage during the past two years but no new estates have come into production. Factories are gradually being brought up to date with new machinery and electric power is now being made available throughout the main sisal growing areas.

40. *Blue Sisal, Agave amaniensis.*—At the end of last year a report was published by the Imperial Institute on their investigations on the fibre of this variety of sisal from Amani, now generally referred to as blue sisal. The results obtained indicated a very promising future for it, particularly in view

of its softness and pliability. Immediately possession of the land had been got for the sisal experimental station the opportunity was taken of clearing and planting out a plot of over seventeen thousand suckers for purposes of further multiplication and provision of fibre for a large-scale test. These have developed rapidly into very healthy plants.

41. *Sisal Experimental Station.*—Excellent progress has been made with the preparation of the station on which a commencement was made only thirteen months ago. Details of the development taking place are given in a separate report. All the area required for immediate experimental and demonstrational work has been cleared and is ready for planting. A nursery was prepared early in the year and contains ample uniform planting material.

42. A number of different varieties of cover crops, exotic and indigenous, have been established for further extended trial. Special mention is made of the value of *Calapogonium mucunoides* for providing a rapid thick soil cover. Observations have been carried out on the sisal weevil in co-operation with the assistant entomologist. While the development of the station was progressing, trials and investigational work have been conducted in collaboration with neighbouring sisal estates, particularly with reference to banding disease, sun scorch and water strain. The quarters for the two officers resident on the station were ready for occupation in November and the laboratory is almost completed.

43. *Coffee.*—The following are the amounts of parchment coffee produced for export over the last four years by districts :—

DISTRICT	1932 Tons	1933 Tons	1934 Tons	1935 Tons
Arusha (with Mbulu) ...	1,329	2,223	1,316	2,914
Moshi	2,539	2,387	2,891	4,336
Usambara	239	166	172	179
TOTALS ...	4,107	4,775	4,379	7,429

44. These amounts were railed via Tanga or Kilindini as follows :—

PORT	1932 Tons	1933 Tons	1934 Tons	1935 Tons
Tanga	1,509	1,726	1,194	2,084
Kilindini	2,598	3,049	3,185	5,345
TOTALS ...	4,107	4,775	4,379	7,429

No appreciable difference has been made in the direction of movement of coffee as a result of the new curing works at Moshi since only a small quantity has passed through them.

45. The amounts of (A) estate and (B) native coffee produced for export over the past four years are as follows :—

DISTRICT	1932 Tons		1933 Tons		1934 Tons		1935 Tons	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
Arusha...	1,285	44	2,123	100	1,271	45	2,829	85
Moshi ...	1,506	1,033	1,378	1,008	1,361	1,530	2,418	1,918
Usambara	224	15	151	15	152	20	167	12
TOTALS...	3,015	1,092	3,652	1,123	2,784	1,595	5,414	2,015
GRAND TOTALS	4,107		4,775		4,379		7,429	

46. The figure for the Arusha district is approximately seven hundred tons greater than the previous highest total in 1933. The better season combined with extra tonnage coming in from the new areas of Oldeani, Babati and Kiru account for this. In comparison with last year there is a significant increase from the area between Arusha and Usa amounting to three times the quantity of crop. The figure for the Moshi district is also a record and represents an increase of nearly fifteen hundred tons. In these totals is the carry over from the previous season's crop. Compared with last year this carry over has been more favourable by nearly seven hundred tons.

47. If the whole of the credit for the substantial increase in crop could be put down to the results of improved methods of cultivation and management the position would be highly satisfactory. As it is, however, many trees have borne too heavy a crop and finished the season in an exhausted and impoverished condition. This does not mean that a general improvement in methods of cultivation is not taking place. Close collaboration between planters and officers, both of the department and from Amani, during the past few years has contributed greatly to a thorough appreciation of the problems involved. The interchange of ideas, observations and discussions together with the trials which have arisen out of them has been of great value. The increasing attention being given to pruning and spraying with Bordeaux mixture are particularly notable. Planters everywhere are alive to the value of maintaining leafage on the trees, on which largely depends the carrying capacity and the maturing of a regular bold bean. It is a big step in the direction of consistent annual bearing and improved yields. Pruning is also a factor in regulating the quantity of leaf and the crop to be borne.

48. The great benefits to be derived from careful attention to practices such as pruning and spraying are especially evident on well managed plantations, but there is the other side of the picture to which the Agricultural Officer, Moshi, draws attention as follows :—

> "Growers are apt to think that for every pest or disease the expert can produce a spray which will drive away the pest or disease and renew the health of the plants. An implicit reliance on a 'dawa' is a point of view which is only too readily accepted, forgetting that the first essential is to give plants the best possible environment. The disease *hemileia* is a good example of this. That a proper spraying at the right time on vigorous trees is economically worth while few present-day planters will deny, but it is also possible that a great deal of spraying is done on trees which are not capable of repaying this expenditure. This may be due to a variety of causes, such as genetically unthrifty trees, soil impoverishment, unsuitable or inadequate shade and cultural mistakes. Genetic unsoundness can, I think, be dismissed as a prime cause of uneconomic yields. It is considered that a large proportion of coffee trees are capable, given suitable conditions, of producing crops at least in excess of yields which now satisfy many planters. It is those environmental factors which man can alter wherein lie the possibilities of the general improvement of the coffee industry. Soil impoverishment and soil erosion must occupy a leading place when the subject of unthrifty coffee is being considered ; there are instances where the land is so impoverished that it is unlikely that it can ever be restored to fertility by any method available to the planter."

49. *Native Coffee.*—The production of native-grown coffee on Kilimanjaro reached the record output of 1,918 tons parchment. Regarded only in the light

of the current season's crop 1,568 tons had been secured by the end of December and the total crop is estimated at 1,900 tons. A part of this increase is accounted for by young trees coming into bearing. The quality of the crop produced has been favourably reported upon by merchants. With the steady propaganda and education the cultural side of native coffee cultivation continues to make satisfactory progress. The communal and co-operative spirit engendered amongst the natives of Kilimanjaro are important factors in connection with our work amongst them, and the force of public opinion is a powerful aid in assisting to maintain a standard of agriculture which is good. In all agricultural work the department has had the closest co-operation of the Kilimanjaro Native Co-operative Union staff, whose primary activities are connected with the coffee industry.

50. During the course of the year over thirty-one thousand inspections of coffee plots have been carried out by the two agricultural assistants and their staff. Apart from the cultural side of coffee in particular a great deal of their time has been given to the instructional side of anti-erosion measures, when seldom a day passes without some work being executed on this all-important question. Close touch has been kept with the Coffee Research Station at Lyamungu. Both officers and their instructor staff have visited the station several times in the course of the year, visits have also been made by members of the Kilimanjaro Native Co-operative Union and some chiefs as well.

51. No significant progress has been made with the native growers on Mount Meru. These people do not show either the same interest or capabilities as their neighbours on Kilimanjaro. The production amounted to eighty-five tons which was sold by tender, but this method of disposal of crop cannot be said to be satisfactory. In the Usambaras the total number of growers is now just over seven hundred. During the present year inspection and instructional work has been more continuous as a result of increase of staff. Two local instructors have been sent to Kilimanjaro for a course in coffee culture and an experienced instructor from Moshi drafted temporarily to Lushoto. The introduction of coffee rules under the Native Authority Ordinance has led to a marked improvement in the standard of young coffee in contrast to the old plots planted before the rules were brought in. The total yield of native coffee in the Western Usambaras is approximately twelve tons. The crop was graded and sold at organized markets to holders of buyers' licences. The growers have evinced a desire to form themselves into an organization and it is hoped that this will lead to a greater interest in cultivation, preparation and marketing.

52. *Coffee Pests and Diseases.*—The early onset of the main rains in the middle of February made it difficult to carry out the whole of the spraying programme as effectively as could have been wished. "Block spraying" against *antestia* was carried out on Kilimanjaro and Meru. It is evident from the reports on the native coffee on Kilimanjaro that the results were good. The Agricultural Officer, Arusha, reports that *antestia* in his area has been noticeable by its almost complete absence. Little thrips damage has been reported and perhaps the earliness of the rains had something to do with this. In the Arusha district leaf miner has been of very little importance but was the cause of much leaf fall in all areas around Moshi. The annual stem borer campaign on native plots is now a matter of routine. On this point the Agricultural Officer, Moshi, remarks: "Prosecutions have been few, public opinion has been so mobilized that defaulters are coerced by their neighbours, or their plots are cleaned by communal efforts." The work of eradicating host trees from

native lands around Arusha has been continued, nearly ninety thousand of these hosts of white stem borer have been dealt with in the course of the year. The position in this respect is satisfactory for the opinion of the Agricultural Officer, Arusha, is that now "it is impossible for any heavy infestation to take place from any other source than badly infected coffee in the neighbourhood." In certain areas in particular white borer is still a serious pest in coffee and it must be mentioned that there are plantations in such areas which do not maintain a sufficiently well supervised and trained gang to carry out control methods. Sporadic efforts to evade conviction seems to be the method of this suicidal policy. Isolated instances of the fringed scale of coffee have been recorded and in each case have been easily and effectively dealt with by uprooting and burning.

53. On unsprayed plantations *hemileia* has been serious, weather conditions in the early part of the year being extremely favourable to a severe attack. It has caused heavy leaf fall in all areas especially on trees attempting to ripen a heavy crop. Spraying against *hemileia* is regarded rightly as a necessary routine measure on the best managed plantations. Unfortunately the past season has been anything but favourable for getting the best results, rain came early and later in the season the atmosphere was unusually humid. If the outbreak was controlled to some extent in the early cropping period, it appeared quite severely later on when the trees were weakened with the strain of ripening a heavy crop. A collar rot on coffee on two estates in the Eastern Usambaras was suspected by the Plant Pathologist to be due to the incidence of a mealy bug.

54. *Experimental.*—The administration, progress and work of the Coffee Research Station at Lyamungu is dealt with by the Chief Scientific Officer.

55. Mr. Sturdy, Agricultural Officer, Arusha, made further observations in November on the old Selian shade experiment. Selections of the shaded and unshaded trees upon which experimental work had been carried out in previous years were excavated for the examination and measurement of their root systems. Although it appeared that a difference existed in the quantity and distribution of roots, the precise details on these points are not yet available. Crop weighing for the uniformity trials, conducted by the research station, was carried out on two selected estates. A similar trial on an estate in the Usambaras was attended to by the Agricultural Officer, Lushoto.

56. Mr. Sturdy, after making careful observations in a general way over a number of seasons in the Arusha district, has arrived at the following conclusions which may be summed up briefly as follows :—

(1) The strain of a large crop is apparent as early as the middle of March, at which time certain trees are showing no new growth.

(2) Mr. Nutman, Plant Physiologist, Amani, has demonstrated that certain trees were already at that time drawing upon their carbohydrate reserves.

(3) Stripping before the end of March is of value.

(4) Careful pruning to leave abundance of non-bearing shoots and adequate spraying against thrips and *hemileia* are both of assistance in preventing overbearing.

(5) Neglect of weeding immediately after the monsoon rains causes yellowing and a loss of crop from dieback ; this is put down to nitrogen starvation.

(6) Cold clear nights with temperatures down to 43°F. causes severe "scorch" on trees in a strained condition.

(7) Yellowing is worse on the lightest ash soils. The Chemist of the Coffee Research Station has made preliminary investigations on these soils and has found comparatively low content of available manganese compounds in the soil and a correspondingly low amount of manganese in the leaves of yellowing plants, as compared with healthy trees.

57. Samples of parchment coffee from various estates have been obtained as in previous years for the Geneticist, East African Agricultural Research Station.

58. *Coffee Curing Works.*—A licence was granted to establish a coffee cleaning and curing works at Moshi. The factory was completed and started operations at the end of September. From that date to the end of the year 758½ tons of parchment coffee were dealt with. The current year's working of the factory must be regarded as a preliminary trial season when the capabilities of the works were being tested out. In some quarters it was expected that immediately a local factory was working that the bulk of the coffee would be sent for treatment through it. There are many considerations to be taken into account in that first other firmly established works exist and secondly not only producers but buyers are conservative in their dealings and exacting in their requirements. In the latter respect, for example, the position regarding the handling of the native coffee crop may be mentioned. It has been pointed out above that the crop was sold forward in parchment to the buyer with presumably due regard by him to the basis of the previous year's outturn. In this case, therefore, the decision regarding the cleaning of the coffee is entirely in the hands of the buyer. The competition which arises from the provision of extra curing facilities is bound to do good, and already this season curing charges have been very considerably reduced to the benefit of the producer.

59. *Tea.*—Two estates in the Usambaras have been producing throughout the year. One estate is entirely under tea and has its own factory, the other is a neighbouring coffee estate which has a small area of tea and supplies green leaf to the factory. Production of tea has shown a substantial increase; 66,891lb. this year as against 26,354lb. last year. Attempts are being made to retrieve the past evil effects of soil wash, an indigenous *Desmodium* soil cover is most promising and is being established. The Plant Pathologist has made visits in connection with *Armillaria* root rot which has been causing so much trouble. Experiments have been laid down to test the rate of decay of forest stumps under various methods of treatment.

60. *Cocoa.*—Only one estate is producing any quantity of cocoa the export of which has been 5·98 tons this year. The price offered has fallen considerably owing to one of the former principal buyers' withdrawing from the market. As yet no great development has been made in the establishment of suitable shade, though more careful attention has been paid to plant sanitation methods.

61. *Kapok.*—The production of 72·8 tons of kapok to the value of £2,804 is greater than last year but is still low on account of the drought effects on the trees in past years. Trees have recovered now and are carrying a very heavy crop. Production in the next few years should show a considerable increase in view of the greater interest and development which has taken place recently. Almost half the area in one district has not yet come into bearing. There are now nine estates in the Korogwe area on which kapok is the principal crop.

62. *Cinchona.*—Very little bark has been exported this year. A few scattered plantings occur in the Usambaras, parts of which as regards soil and climate seem eminently suitable for its growth. Remunerative prices have been realized for parcels of bark and a certain amount of interest is being shown by planters. If they felt more assured of the future prospects, there is no doubt that more interest would be taken.

63. *Copra.*—There has been a fall in the export figures from 1,510 tons in 1934 to 560 tons valued at £4,399. Locusts have severely defoliated the palms at a time when they were suffering from the effects of drought. As a result of poor prices plantations have been badly neglected and many were in such poor condition that numbers of palms died outright. Hitherto Zanzibar has been the chief market but this year there has been an abnormal trade for green nuts both locally and to Mombasa. The trade in fresh nuts has been far more profitable than turning them into copra. The soap works in Tanga has also consumed an increased quantity of what copra was produced.

64. *Cotton.*—The quantity of seed-cotton produced by native growers has amounted to 1,266 tons, which includes a carry-over of 69 tons from the end of last season's crop. This total compares with 245 tons for the previous year. The amount marketed as No. 1 quality came to eighty per cent of the total and the money which has gone into the pockets of the growers has been £10,669. Non-native growers have produced 701 tons of which 376 tons were from the Moshi area, 301 tons from the Mbugwe area and 24 tons from Arusha.

65. Too much of the native cotton was late planted. Dry, sunny weather needed to ripen off early plantings did not occur at the time it was wanted but this disadvantage was more than offset by the benefit to the late plantings of the continuation of unexpected cloudy and damp conditions. Boll-worm caused some damage in restricted areas and internal boll rot was responsible for loss of crop on irrigated cotton in one locality.

66. *Maize.*—During the year 4,257 tons of maize and maize flour were railed from Moshi district and 329 tons from Arusha down the Tanga line, whilst 987 tons were exported over the Kenya-Uganda Railway. This represents a substantial increase over last year's figures and is due to the greater acreage brought into production. Not only has there been considerable development amongst non-native growers but also the natives have increased their production. Although good individual yields have been got, the season has not been so favourable as last year.

67. *Citrus.*—The smallness of the output this year has been due to the check to trees by both drought and locusts previously. They have recovered and will bear heavily in 1936. Shipments of both oranges and grapefruit were sent to London and oranges to Bombay. The report on the Bombay consignment was disappointing. The flavour was reckoned to be fairly good but owing to the poor colour and size, some difficulty was experienced in disposing of the fruit. South Africa has recently entered this market and it is considered that it will be difficult for the present Tanganyika orange to compete with the high class South African product on the limited Bombay market. The London consignments have not yet been reported upon. Previous trial shipments had demonstrated that the wastage figure was variable and might be connected with the amount of acidity. Shipments this year were for the purpose of ascertaining information on this point. Last year's consignment of grapefruit was favourably commented upon but for the presence of pitting on a large proportion of

the fruits, and trials are being carried out to determine methods of control of this.

68. The bulk of the orange production is in the hands of natives and they are extraordinarily careless both in regard to the care of their trees and the harvesting of the crop. Work is being done on the small citrus station at Muheza to raise better material for further plantings, and extensive work is being carried out with a view to getting growers to take more interest. There has been a very lively trade this year for oranges for export to Mombasa and thence to Italian Somaliland. High prices ruled and a scramble to harvest fruit in any condition. Very little interest has yet been shown by planters in citrus production.

69. *Other Products.*—(i) Following upon the visit to the Territory of an expert on the subject of essential oils a new export has arisen in equellor oil from one estate near Tanga which had in existence old established groves of Seville orange trees. The production does not entail heavy capital expenditure and with the remunerative prices output may be expected to increase. A sample of leaves submitted for examination to the East African Agricultural Research Station gave the very good results of 35 per cent of oil with 76 per cent of esters. There is also every likelihood of the distillation of Neroli and Petit-grain being undertaken.

(ii) There are good indications that plantations situated on the north side of Mount Meru will be able to produce Pyrethrum satisfactorily. Tests made by the Biochemist, Amani, on a small sample of flowers show that toxicity equal to the best Kenya can be obtained. Experimental plantings are flourishing well. Considerable interest is being evinced in Derris which promises to be suitable for the Eastern Usambaras. A sample of two-year-old roots analysed at Amani gave the very good yield of 8·7 per cent rotenone on a dry weight basis; as was to be expected the weight of root from the immature plants was low. At present planting material for development is scarce locally.

(iii) *Ramie.*—Samples of fibre and bark strips have been sent to interested buyers in England from plantings in the Tanga area, in addition inquiries have been received for dry stems. The Agricultural Officer, Tanga, reports: "Comparison of the rates of growth in the two areas indicates that the crop requires a higher rainfall than that obtained on the Tanga plains and that the Eastern Usambara foothills would provide more or less ideal conditions." Trials are being laid down in a number of areas to try out this crop on a small scale both as rain grown and with irrigation.

(iv) Interest in tobacco growing is being maintained, the production, however, is as yet very small, about fifty tons. It has received prominence as a crop in the Usambaras recently due to the installation of a cigarette factory at Makweri, near Amani. Originally started with hand machines it has now become more mechanized. The owner grows tobacco himself and also issues good seed out to neighbouring natives who sell the crop to the factory. Tobacco growing amongst natives in the Usambaras is fairly extensive, the market for the product being amongst the labour on the sisal estates.

(v) By the end of the year five Telfairea-nut plantations with a total of just over fifty acres have been planted in the Western Usambaras, two of these are in bearing. In all cases the vines are trained on specially erected framework seven feet off the ground. At present a considerable local demand for the nuts from natives exists for they pay one cent per nut. Later on an external market will be necessary.

(vi) Potatoes are grown in some quantity in the Usambaras, the amount exported out of the district totalling approximately 150 tons which is an increase of 50 tons over last year. The Agricultural Officer, Lushoto, remarks: "This is another crop in which there is room for expansion in export. Only a small proportion of the potatoes grown by natives is exported, the remainder being consumed locally. The supply is based very closely on demand, exports not being possible because potatoes are perishable in the hot coastal climate. The potato crop is one of the few crops which the natives take the trouble to manure, though in all cases it is with a view to preparing ground for the planting of tobacco."

(vii) The native-grown wheat export from Kilimanjaro amounted to 21 tons and that from the Mbulu district is as yet only a few tons. Farmers on the north side of Meru were able to secure a small crop after two seasons' complete failure. The yield averaged out at only four bags to the acre, the total production being 343 bags.

(viii) An export of 294 tons of onions have been railed from Moshi, the bulk of it going to Kenya, only 14 tons being sent down the Tanga line.

70. The Muheza citrus demonstration plot has been increased in size to the extent of an acre to take in land required for development in nursery work. This is in order to supply trees to both non-natives and natives and sufficient material has been planted to have available in 1936 about ten thousand plants, Rough lemon and Seville orange being used as understocks. Fourteen schoolboys each have their own plots and are being taught nursery work. The soil is lacking in humus and compost pits have been made for demonstration purposes and to supply the deficiency. The Handeni seed farm has been used for multiplication purposes. Of special interest in this connection was the yield of seven tons of cassava off one acre, a proof of the utility of this crop in one of the drier areas. Fair yields of the staple crops were harvested from the Lushoto native authority farm. Four tons of edible canna were distributed in out-districts to natives. The coffee plot flourishes and will be allowed to bear a crop next year. A building for the stall feeding of six cattle has been put up. To provide the necessary material introductions have been made of lucerne and varieties of fodder grass. Except for peaches and mulberries the fruit trees originally put in have not been a success; some are to be replaced with fresh stock. The Lushoto prison farm on which maize and potatoes mainly are grown has been supervised. A new area of ten acres has been opened up and is being used as demonstration of contour lines of weeds and indigenous hedging matering as a means of countering erosion.

71. *Locusts.*—Numerous swarms of the red locusts were present in the first half of the year in both the Tanga and Northern Provinces. Entrance of these swarms was from a southerly direction but the main infestation was in a belt from the coast as far east as the borders of the Same district. A lesser infestation occurred in the Mbulu district in the line of the Rift Wall, but the centre belt comprising Moshi and Arusha was comparatively free. Considerable egg-laying took place. Fortunately these swarms and the hopper bands were closely attended by large numbers of birds and disease was rife, both of these controls exercising a big influence on the position. Particularly in the Muheza locality, which is an intensively cultivated area, exceedingly good destructive work was carried out by the Labour Officer assisted by the native authorities. The damage caused by locusts to food crops has been negligible,

there was, however, severe defoliation of coconut palms, citrus trees and bananas. At the end of the year the area was clear of locusts.

72. *Agricultural Shows.*—No agricultural shows were held during the year; for several reasons the provincial agricultural show which was anticipated in last year's report did not take place.

73. *General.*—The Director of Agriculture visited the Tanga Province three times and the Northern Province on five occasions. The Acting Director visited Tanga once. Other visitors to Moshi included the Director of the East African Agricultural Research Station; the Director of Agriculture, Uganda; Mr. A. D. le Poer Trench, Senior Coffee Officer, Kenya, in connection with research at the Coffee Experimental Station; the Treasurer; Major Sir William Lead, M.C.; Mr. S. Milligan, C.B.E., C.I.E., on cotton matters; Mr. R. S. Wollen, Chairman of the Kenya Coffee Board; and Colonel G. C. Griffiths, General Manager of the Kenya Farmers' Association; Mr. H. C. Ducker of the Nyasaland Cotton Station visited the Northern Province to conclude his tour of some of the cotton areas of the Territory. Mr. W. Millar, Engineer of the Malarial Survey Unit, spent a week in the Same district on the Ruvu irrigation project. The Senior Agricultural Officer attended the coffee conference held in July at Nairobi. The Agricultural Officer, Moshi, visited Mombasa in December to attend coffee auctions and to see the curing works. As a result of visits received, and those paid, valuable contacts have been effected.

74. Generally speaking the year has been a propitious one. All the staff have had an extremely busy time, they have not spared themselves and deserve praise for their efforts and for their enthusiasm. It is partly this enthusiasm which makes for good team work and begets the close co-operation between ourselves and others which is so necessary.

R. M. Davies,
Senior Agricultural Officer,
i/c North-Eastern Circle

Annexure II

ANNUAL REVIEW OF THE NORTH-WESTERN CIRCLE.

Lake and Western Provinces.

Staff.

During the year a ginnery inspector was appointed to the Lake Province and an agricultural assistant to the Ukiriguru extension at Nyamahona. So far, it has not been possible to post agricultural officers to the increasingly productive districts of Musoma and Bukwimba and at present these areas are supervised by the officer stationed in Maswa district; and there is ample scope for the activities of an additional officer in the islands and lake shore area.

2. The departmental native staff proved inadequate and as in previous years was augmented by the instructor staff employed by the native authorities, and by temporary recruitments made during the cotton marketing, seed distribution and planting periods. In the Western Province, the cotton campaign necessitated the employment of a large temporary staff who were paid by the native authorities.

General.

3. The various areas of the circle have been described in previous annual reports. Organization was on the lines of previous years with the exception that more particular attention was given to the establishment of peasant holdings.

The general conditions pertaining to the various districts throughout the period under review were briefly as follows:—

4. *Mwanza.*—The early planting rains were good but were followed by a dry spell in January which caused considerable anxiety. In February good rains which continued into March were general and eased the position considerably. The rains throughout March were moderate but were followed by heavy rains in the first fortnight of April and then by light rains in early May with heavy showers continuing into June. From the above it will be seen that weather conditions were fickle and crop estimates throughout the period fluctuated considerably. The prolonged drought in January created a set-back to planting and reports were received of locust swarms and egg-laying in several areas. An extensive root planting campaign was launched by the administration to guard against the failure of cereal crops and as an anti-locust measure.

The heavy rains in May damaged early planted cotton and ripe cereals, but in June conditions improved and the general position was that food crops were ample, groundnuts normal, rice above the average of previous years and, late plantings having proved successful, a record cotton crop.

5. *Maswa.*—The early rains were favourable and record acreages of all food crops were in the ground by the end of December. Maize and sorghums suffered owing to the drought in January but good rains fell in the early part of February and all crops made good progress. There was a dry spell in March, when early planted *feterita* was harvested, but excellent rains fell in

April and crop prospects were good. In early May the harvesting of cereals, groundnuts and early planted cotton commenced.

Weather conditions generally were favourable and the season resulted in ample food crops, a record cotton crop and the highest export of groundnuts since 1930.

6. *Kwimba.*—Early planting rains were good and record acreages were put under food crops while the acreage prepared for cotton was estimated at double that of the previous year. Abnormal rains fell in May which benefited the late planted groundnut crop but damaged the early planted cotton. The season finished with record cotton and groundnut crops, ample food supplies and a rice crop well above the average.

The groundnut crop sold in the markets amounted to 4,239 tons and the rice to 1,572 tons, while the cotton approximated 7,550 bales.

7. *Shinyanga.*—The early rains were good and an extensive root planting campaign was organized by the administration—one ton of sweet potato cuttings being sent from the Mwanza lake shore areas. January was dry but welcome rains in February terminated the drought and the position was that the acreages under cereals, root crops and cotton had increased considerably while a decrease was recorded in the acreage under groundnuts. This was probably due to the seed supplies being depleted owing to food shortages the previous season.

The March rains were poor but those in April were good, while in May they were abnormally heavy. The final position was a record cotton crop, good rice crops in Lohumbo and Tinde areas and over two thousand tons of groundnuts marketed. The food supply was good in all areas.

8. *Musoma.*—The early planting rains were favourable and extensive areas were planted with cotton, groundnuts and rice. A dry period was experienced in January but this was compensated to a certain extent by good March rains. The position at the end of the harvest was below average, food crops good and a record cotton crop of approximately three thousand four hundred bales.

9. *Biharamulo.*—Early rains were good but a dry spell was experienced in January. February rains were normal but March was abnormally dry and seriously affected the tobacco crop. The drought continued into April followed by heavy rains in May. Food supplies were ample and in spite of the adverse conditions the tobacco crop was estimated at twenty-five tons.

10. In spite of the abnormal weather conditions the resultant harvests were good and a record cotton crop was obtained in all areas. The distribution was approximately as follows :—

Mwanza	17,000 bales.
Maswa	7,450 ,,
Kwimba	7,550 ,,
Musoma	3,400 ,,
Shinyanga (U/4/4/2 areas) ...	4,600 ,,

The final figures are not yet available, but the approximate figures are 40,000 bales as against 26,400 the previous season.

11. Cotton is now established in the Mwanza, Musoma, Kwimba and Maswa districts and production should increase, or at least remain at its present high figure. Given a normal year, there is no reason why the Lake Province should not produce 75,000 bales.

12. In spite of the fall in coffee prices, Bukoba coffee exports were more than maintained and showed an increase of over 650 tons on last year's figures.

Bugufi produced a sixteen-ton crop. The prospects of the coffee industry in this area are very good and marked progress was made in the course of the year.

13. Lake shore rice production shows no decrease notwithstanding the fact that cotton and groundnuts have ousted it from the hinterland. Recent irrigation trials in suitable lake shore areas have produced extremely good results and may lead to a large increase in production.

14. Though the coffee, groundnut and rice crops were satisfactory, there is ample room for expansion and continual propaganda is necessary to get the natives to improve their cultural methods with regard to coffee and to continue to grow groundnuts independent of price fluctuations.

15. In the Western Province the cotton campaign resulted in a small crop of approximately 735 bales. The disappointingly low yields to a large extent due to the presence of disease in all cotton fields, were by no means proportionate to the efforts put forth by all concerned in the campaign or to the amount of seed planted. Cotton is again being tried, on a smaller scale than last season and only in selected areas.

16. Weather conditions in the Kigoma area were generally more favourable to crop production than in Tabora. In Kigoma, the area under rice was again extended and resulted in an increase of more than five hundred tons over the record crop produced last year ; an excellent grain harvest was secured as well as an increase in groundnuts. Tabora, Nzega and Kahama exported a six-thousand-ton groundnut crop which equals the record year of 1933.

Experimental Stations.

17. Too much stress cannot be laid on the importance of the experimental stations. Officers in the course of their duties are called upon to give advice regarding crop production, manuring, etc., and that advice can only be sound if it has been proved by experimentation. It has been shown time and again that it is unsound to experiment at the expense of the native because, in the event of failure, development receives a serious set-back and our influence over him is seriously impaired.

18. It is considered that one of the best ways of securing a sure foundation to agricultural practice in this circle is by the establishment of a class of peasant farmers who will farm the land in the true sense of the word. We frequently come across that hackneyed phrase "to farm the land according to the rules of good husbandry" but one must first discover what the rules of good husbandry are. In this area they can be defined as—"such cultural practices as have been proved by experiment to be sound and applicable to the area in which the farm is situated."

19. What is proved on the experimental station is tried out on a large scale on the native authority farms and from there it passes to the peasant holders. The peasant holdings are small-scale replicas of these farms. Although a great deal of work remains to be done, sufficient positive knowledge has already been gained to satisfy immediate requirements.

20. The agricultural problems in this circle are many and since those of the lake shore differ materially from those of the hinterland two stations are maintained ; one at Lubaga to serve the hinterland and one at Ukiriguru to serve the lake shore.

21. One of the major items at both experimental stations is the selection and improvement of cotton and funds generously granted by the Empire Cotton Growing Corporation have enabled this work to be greatly extended.

22. During the past few years there has been a definite desire on the part of the natives for agricultural knowledge and instructional classes have accordingly been started at Ukiriguru and Lubaga. The native authorities have offered to erect a school at Ukiriguru and it is hoped that building work will commence in the near future.

Native Authority Farms.

23. It has been stated in a previous paragraph that what is proved on the experimental stations is tried out on a large scale on the native authority farms. It will be seen, therefore, that these farms are a necessary auxiliary to the experimental stations. Apart from the production of pure seed supplies for ultimate distribution to natives, these farms act as training and educational centres, demonstration farms and ploughing schools.

24. With regard to mixed farming at the Ukiriguru native authority farm, the Agricultural Officer reports: "On the seed farm, which is run in conjunction with the experimental section, cattle are used as far as possible and the experience gained is of great value in framing the policy and lines of work for the cultivators who have taken up mixed farming under our control.

"The feeding of stock is perhaps the most important point in the mixed farming practices and it has been found that the work oxen can be kept in good condition and that female stock give milk yields of much above those obtained by natives, due to the provision of feed which any cultivator can provide. Although grazing is very limited, very full use has been made of it by the practice of tethering and this, coupled with roughage such as maize stover, groundnut haulms from the arable land and small quantities of elephant grass grown specially as fodder, have maintained all stock in excellent condition.

"The making of millet hay and maize silage, the former yielding three and three-quarter tons per acre and the latter twelve tons per acre, have been successfully carried out, but only as the stockowner realizes the benefit of good feeding can he be expected to carry out such practices of his own free will. A small sun-dried brick silo, ten feet in diameter and five feet deep, was tried this season and good silage was taken from it. This type of silo can easily be made by natives and should be useful where it is impossible to dig pit silos."

25. During the year a native administration rice multiplication area was established at Mwabogole on the lake shore; this area is run as a sub-station of Ukiriguru native administration farm. Twenty acres of land can be irrigated by means of furrows and a pumping plant, water being pumped from a channel cut direct to the lake. Spacing experiments and strain trials were planted in May and June and made excellent growth, some exceptionally high yields being obtained.

26. The Lubaga experimental station, now organized on the lines of Ukiriguru, is run in conjunction with a native authority seed farm of three hundred and twenty acres which is intended to serve the natives of the hinterland as an educational centre in all matters pertaining to agriculture. The four native holdings which have been laid out, two at Lubaga and two at

the Ibadakuli extension, have aroused a considerable amount of interest amongst the natives. One of the problems at Lubaga lies in the restoration and maintenance of soil fertility and consequently anti-soil erosion measures are taking a large part in the farm programme.

27. Similar farms on a smaller scale but with the same objects in view are maintained in the Maswa, Biharamulo, Tabora, Kahama and Kwimba districts, the two latter farms being run in connection with the native authority schools.

28. *Mwasita Seed Farm* (Maswa).—This farm, which is used mainly for the production of *ferterita* sorghum, is in process of reorganization. New labour lines and a cattle boma have been built and a new store is in course of construction. The dam has been enlarged and a new entrance road completed.

29. *Shanwa* (Maswa).—The demonstration of mixed farming, erosion control, methods of increasing fertility, the use of implements and the trial of exotics are carried out here.

30. *Shanwa School Farm* (Maswa).—The officer in charge reports : "Careful supervision has been given by the school teacher to the sowings arranged for by my predecessor, with the result that the farm was a picture of orderliness on my arrival, with every possible crop well represented and well grown. The various cultural details such as rotation, manuring, erosion control and making of silage and composts were suitably demonstrated."

Ngudu (Kwimba).—Approximately twenty acres of land are cultivated each season when ox-drawn implements are used. Soil erosion control is demonstrated and the manufacture and use of farmyard manure or composts. Animal husbandry is taught, including the keeping of pigs. Food crops from introduced seed are grown by improved methods, both for teaching purposes and to provide food for the boarder pupils.

31. *Tabora*.—The Agricultural Officer reports : "School gardens have been maintained at Nzega and Kahama native administration schools. These are designed to demonstrate rotation of crops, green manuring and anti-soil erosion methods. They incorporate also a selection of indigenous and introduced crops, and varieties of crops, with a view to encouraging diversity of cropping, seed selection and the choosing of crop varieties to suit local conditions. At both these schools the boys are given an opportunity to learn how to plough and to handle work oxen.

"The only seed farm in the area is that at Ndomo (Nzega). It has been used for the multiplication of such introduced crops as Virginia bunch groundnuts, awned bulrush millet, white cango maize and *feterita* sorghum. The farm also serves as a ploughing base for the training of oxen and plough boys, and for the manufacture of ensilage for the ploughing teams, which, for the past two seasons, have been hired out to natives. The farm also demonstrates anti-soil erosion methods, green manuring and the manufacture of farmyard manure.

"An area of eight acres on Kazima prison farm is used by the department for any observations which the local agricultural officer may wish to make, and for the multiplication of improved varieties of seed. The plots, which are covered by a wide diversity of crops and are planted well in advance of the crops of surrounding natives, act as an excellent demonstration to the gangs of short-term prisoners who reside at Kazima. The whole of the departmental

area is cultivated on the tie-ridging system which has proved highly effective in arresting erosion and conserving all of the thirty-six-inch rainfall. The plots are situated on a steep slope and the soil is fairly porous.

"An area of four acres at Ndono (Tabora) is used as a demonstration farm under the supervision of an African instructor. Crop rotation, green manuring, use of kraal manure, sisal-hedge planting, wind breaks, fruit trees and flower culture form the main features. The appearance of the plots and condition of the crops thereon last season formed a pleasing contrast to plots of surrounding natives, in spite of the fact that the plots are sited on ground abandoned by natives as useless."

32. *Biharamulo.*—The Agricultural Officer reports as follows: "The main function of Mtungamo seed farm has been seed multiplication of tobacco, maize, groundnuts and multiplication of disease-free sets of cassava. An observation plot of arabica coffee was also maintained. Demonstrations of contour ridging, contour trenching in coffee, cover cropping, green manuring, compost manuring and mulching were also available."

Ploughs and other Farm Implements.

33. It will be evident from the following extracts taken from agricultural officers' reports that the value of the plough and other implements is being increasingly recognized by natives.

Maswa.—"A number of natives are taking to the plough. It has been pleasing to note oxen and ploughs working efficiently in various parts of the district without active encouragement. In fact, inquiries have been made for the purchase of ploughs and spare parts, and it is obvious that surplus cash from export crops will be more widely devoted to the purchase of such implements as time goes on. We have given service at Mwasita in the training of pairs of oxen together with their owners."

Kwimba.—"The use of ploughs and implements is demonstrated with each planting season at the school farm, Ngudu; ploughs belonging to the native authority are hired out to natives who want them at one shilling per day. The larger cotton plantations belonging to the chiefs are cultivated in this way."

Kahama.—"With the exception of a few chiefs in Nzega, no one uses ploughs in the area, chiefly because no one can afford the capital expenditure involved. The method of popularizing ploughing by hiring out ploughs from Ndono farm again proved a success, and the demand was far in excess of the supply."

Shinyanga.—"Many ploughs were hired out to the natives at the cost of two shillings per day. This practice has proved itself extremely popular, and has accomplished the desired effect of popularizing the use of ploughs among a limited type of cultivator. It is considered, however, that this practice, if continued, will defeat its own end as the natives will invariably choose the easiest way possible, i.e. the natives will prefer to continue to hire—rather than to purchase their own ploughs. During the later part of the season this privilege was withdrawn through shortage of oxen and several ploughs were purchased by natives.

"It is gratifying to record that four chiefs have purchased inter-row cultivators for use on their own gardens. Undoubtedly inter-row cultivation has impressed itself upon the mind of the local native.

"Pneumatic-tyred ox carts were used on the native administration seed farm at Lubaga. Converted motor vehicles have been proved successful, and Dunlop conversion sets for the two-wheel ox carts are now being tried out. There is every reason to suppose that these will be successful and that they lie within the possible reach of the chiefs and the more prosperous native cultivators."

Native Holdings.

34. These have been fully described in the last two annual reports. The two original holdings at Ukiriguru have prospered and have proved that it is practicable to establish native cultivators on fixed holdings. Both owners worked well during the year and reaped good crops; their cattle have never lost condition, and the cow of one of the owners took first prize at the agricultural show milking contest; in addition, both men have improved in physical and mental ability.

35. The Agricultural Officer, Ukiriguru, reports on the holdings as follows: "Four new holdings on the perimeter of the farm were taken up this season but as they started very late they were not asked to carry out the full cropping scheme. The two established settlers have done well. They harvested good crops and worked their holdings on the lines laid down for them and there is no doubt that a much greater acreage than that cultivated by the ordinary cultivator can be cropped and fertility maintained at an economic level under the system of mixed farming, the condition of their stock is a striking example of what better feeding and housing can do for the native cattle.

"The total number of hours worked on each holding during the season of three hundred days averaged 2,776 which, taking it that both man and wife worked the same amount, is just over four and a half hours work per day per individual. The cash return this season was much lower than last, averaging thirty-four shillings per holding; this was due to their poor cotton crops and the fact that they consumed all milk which previously they had sold. Against this their food crops were excellent and actually there is a surplus available for sale. Their standard of living is high with their better housing and very ample food supplies, being much better than most native cultivators.

"With practice in using their work oxen the holders have been able to use the wooden plough and cultivator to a much greater extent, and they are now asking for imported implements, but as the former have proved capable of the work demanded they are to continue with these until they can purchase improved implements out of their own earnings."

36. Sixty-two settlers have taken up twenty-acre holdings at Uzinza and, although the large amount of clearing work did not allow them to get a full acreage under crops this year, they made fair progress and obtained sufficient food and cash crops for their needs. The four demonstration holdings in the Shinyanga district gave satisfactory results, and it is proposed to increase this number. In 1936 it is hoped that demonstration holdings will be established in the Tabora and Kahama districts of the Western Province.

Nyakato (Bukoba) Agricultural Training Centre.

37. Mr. H. Gillman, Agricultural Officer, was in charge until the return from vacation leave of Mr. A. E. Haarer, Agricultural Lecturer, in May. Mr. Haarer left on transfer in June, handing over to Mr. C. Harvey, Agricultural Officer.

Cotton Seed Distribution.

38. Arrangements for the supply and transport of seed by ginners to distribution centres worked fairly smoothly in contrast to the difficulties experienced in previous years.

39. The distribution of cotton seed was as follows :—

Type of seed	District	Amount
Uganda Upland ...	Mwanza	1,700 tons.
	Kwimba	820 ,,
	Maswa	782 ,,
	Musoma	315 ,,
	Shinyanga	45 ,,
	Total ...	3,662 tons.
U/4/4/2	Shinyanga	410 tons.
	Kahama	70 ,,
	Nzega	100 ,,
	Tabora	88 ,,
	Mkalama	40 ,,
	Total ...	708 tons.

40. In addition to the above, demands for seed for distribution in areas outside the circle were also met, the amount being given below :—

Type of seed	District	Amount
Uganda Upland ...	Lindi	30 tons.
	Kimamba	16 ,,
	Kilosa	10 ,,
	Total ...	56 tons.
U/4/4/2	Kimamba	35 tons.
	Kenya	25 ,,
	Total ...	60 tons.

Ginnery Inspection.

41. The Ginnery Inspector was posted to the Lake Province in March. His headquarters are in Mwanza, and his duties involve the inspection, construction and efficient working of ginneries—a very necessary service.

Marketing Improvement and Extension.

42. The system of regulated markets to control the sale and purchase of native produce which was established on a uniform basis in the Mwanza, Kwimba, Shinyanga, Maswa and Musoma districts in 1934 worked smoothly throughout the buying season. Forty-five markets operated in the Lake Province and the produce of which the sale and purchase was controlled included groundnuts, rice, sesame and gum arabic.

43. The quantity of produce in tons which passed through the markets during the period they operated are given below. For purposes of comparison the 1934 figures are shown :—

DISTRICT	Groundnuts	Average price in cts. per lb.	Rice	Average price in cts. per lb.	Sesame	Average price in cts. per lb.	Gum	Average price in cts. per lb.
Mwanza ...	571	6.50	1,962	3.50	12	6.00	—	—
Bukwimba	4,239	7.00	1,572	3.50	7	7.00	73	8.00
Maswa ...	1,807	6.50	5	2.75	26	5.00	—	—
Shinyanga	2,145	7.00	—	—	—	—	347	11.70
Musoma ...	265	7.00	612	4.50	187	7.00	—	—
Total ...	9,027	6.80	4,151	3.56	232	6.25	420	9.85
Total 1934	1,963	3.92	2,262	4.28	58	3.75	432	8.12

44. In the Tabora district of the Western Province, groundnut markets, where the sale and purchase of this product was controlled, were established at three centres; these worked successfully and the natives are reported to have asked for an extension of the marketing system next season.

45. Native markets exist in Biharamulo and arrangements are being made for the erection of market buildings and to regularize the markets as far as practicable.

46. At regulated markets the producer is paid in cash and is ensured a fair price for his produce, they are proving popular with the natives and in this respect the Agricultural Officer, Maswa, states: "The produce markets were thronged during the season and proved once again their efficiency and necessity."

47. The Bugufi coffee crop was marketed in Bukoba by the district officer and the agricultural assistant acting on behalf of the Bugufi Coffee Society.

48. As in previous years, the Biharamulo tobacco crop was marketed by the department assisted by the Biharamulo Agricultural Society.

49. *Cotton.*—The marketing system carried out during the last two years was again followed, the crop being sold at cotton markets, cotton (ginners) markets and tender posts. Fair prices were promulgated by the Director of Agriculture. The marketing of this crop leaves much to be desired and a new scheme is at present under consideration.

50. The tremendous rush by growers to sell their cotton at the opening of the 1934 buying season did not recur this year, although at certain buying centres the amount of cotton coming forward for sale was so overwhelming that the buyers had great difficulty in clearing their stores; large heaps of cotton were in consequence left lying in the open and at two centres damage by fire occurred.

51. The growing of U/4 cotton is confined to the Shinyanga and northern Kahama districts and with a view to keeping this type of seed free from admixture movement from this area was prohibited. As a result of this, the ginners in this area were originally given a controlled buying and ginning monopoly. This year, however, the natives objected to the monopoly with its absence of competition and asked that other ginners should be permitted

to buy. As was foreseen, this arrangement proved unsatisfactory and the chiefs now wish to revert to the old system. The U/4/4/2 crop of approximately four thousand six hundred bales was bought at an average price of eleven cents per pound for first, seven and a half cents for second, and five and a half cents for third quality seed cotton.

52. The Uganda Upland crop of approximately thirty-five thousand four hundred bales changed hands at an average price of eleven cents for first and six cents per pound for third quality seed cotton.

53. In the Western Province, the Uganda Upland crop grown in the Tabora and southern Kahama districts and amounted to approximately three hundred and seventy-five bales. The average price paid for seed cotton was nine and a half cents for first, seven and a half cents for second, and five cents per pound for third quality.

Coffee Inspection and Grading.

54. The inspection and grading of all coffee exports from Bukoba continued throughout the season. The agricultural officer reports: "Since it came into operation grading has eliminated the adulteration of coffee with water and other extraneous matter, and maintained the standard to the general satisfaction of the trade. There can be little doubt but that the position of Bukoba coffee on the world's markets to-day would otherwise be very much more difficult than it is."

55. Particulars of bags graded, inspected and rejected are given in the following table:—

Number of bags of 200lb.

	Graded			Inspected		Total exported	Revenue collected	
	G.A.Q.	F.A.Q.	Triage	Passed	Rejected		Shs.	cts.
Arabica ...	359	33,908	—	4,449	17,212	38,716	19,122	05
Robusta ...	123	81,529	778	63	25,494	82,493	39,050	05
					Total ...	121,209	58,172	10

56. The amount of coffee exported as inspected only (i.e. ungraded) and the percentage of rejections was higher than in 1934: this was due to prolonged rains, resulting in insufficiently dried coffee, and to other factors over which there was no control.

57. The total crop exported was 10,881·57 tons as compared with 10,209·54 tons in 1934. Prices fell, unfortunately, and there was a decline in value of £80,036 on the 1934 figure.

58. The value of this important service to the coffee industry becomes more apparent as time goes on and the smoothness with which the scheme operates reflects great credit on the grading staff and the efficient way in which they carry out their responsible work.

Crop Production.

59. *Coffee—Bukoba.*—Efforts to improve field sanitation, cultural methods and preparation of the crop for market have continued and in this connection the agricultural officer reports: "The position with regard to neglected coffee was greatly improved three years ago when an administrative officer was

detailed to work with the department for this purpose. This has been generally maintained, though some areas show a tendency to revert. Steady progress with the regeneration of coffee has been made; the strong demand for pruning saws exceeded the supply and further orders for fifteen hundred saws were placed towards the end of the year. There is slow improvement with the thinning out of too-closely planted coffee, and with the interplanting of coffee with bananas or mulching with grass. Trials with small metal hullers have been carried out which show that a considerable reduction in breakage of beans can be effected, compared with the local wooden huller, in hulling robusta coffee.

"Exports of coffee reached 10,881·57 tons, exceeding the record 1934 export by 672 tons. New plantings coming into bearing are negligible in comparison with the total area under coffee, and the large increase is considered to be mainly the result of favourable weather conditions in 1934 and early 1935, coupled with the success achieved during the 1934 campaign for control of bean borer. The regeneration of arabica coffee in many areas must also have had its influence on the crop."

60. Comparative export figures in tons are given in the following table:—

	1931	1932	1933	1934	1935
Robusta ...	4,848·1	5,705·9	5,054·02	6,898·50	7,472·83
Arabica ...	1,738·3	1,401·2	2,868·06	3,311·04	3,408·74
Totals ...	6,586·4	7,107·1	7,922·08	10,209·54	10,881·57

61. *Bugufi.*—Coffee cultivation in this area is steadily increasing and marked progress has been made during the year. The following figures indicate the satisfactory position of the industry:—

	No. of Growers	Bearing trees	Immature trees	Nursery plants
1934-35 ...	6,032	28,563	325,476	—
1935-36 ...	6,327	230,985	221,805	130,000

62. The agricultural officer states: "At the beginning of the year, four pulperies were erected by the Bugufi Coffee Society to deal with the 1935 crop. Growers brought ripe cherry to these pulperies where it was measured and credited to the grower. The proceeds of the sale of the crop, less overheads, were then divided amongst the growers in proportion to the number of measures produced. This system worked admirably, and with modifications to suit the greater production should be suitable for the coming year."

63. *Biharamulo.*—The seedlings in the six nurseries established last year are now ready to transplant and will be planted out only in selected areas in this district. These nurseries were prepared with the primary object of compensating coffee growers who had to abandon coffee plantings on moving into the concentrations.

The demonstration plot of coffee at the Ntungamo seed farm has been maintained.

64. The small coffee industry in the Kibondo and Kasulu areas of the Western Province continues but without great success: when planted in selected soil and given proper attention, coffee may be expected to give moderate results in these areas. The Kibondo native crop amounted to approximately one ton and was sold locally.

65. *Cotton.*—Cotton has proved a popular economic crop and is well established in the Mwanza, Maswa, Kwimba and Musoma districts. No

propaganda is now necessary in these areas to persuade the natives to take seed and in fact the main difficulty is in meeting their seed requirements and in controlling distribution.

A record crop, estimated at 40,000 bales, was harvested and had it not been for disease and excessive rains late in the season which affected both the quality and quantity of the lint, this figure would have been largely exceeded. The approximate amounts produced in each district are as follows : Mwanza, 17,000 bales ; Maswa, 7,450 bales ; Kwimba, 7,550 bales ; Musoma, 3,400 bales ; Shinyanga, 4,600 bales.

66. In the Kahama and northern Nzega districts of the Western Province the growing of U/4/4/2 cotton was continued and resulted in a crop of approximately 360 bales. Owing to pests and diseases the crop of Uganda Upland cotton obtained in the Tabora and southern Nzega districts was disappointingly small, amounting only to 375 bales approximately. Observation plots were laid down this season in the Kigoma area but yielded no conclusive results. Trials are being continued.

67. During the buying season fire broke out at two buying centres in Musoma and Kwimba districts respectively, the amount of seed-cotton damaged being estimated at 300 tons.

68. *Groundnuts.*—This is an important crop and is becoming more popular as a food, the hay provides useful fodder and it fits in well with schemes to maintain the fertility of the soil. Export figures from the Lake Province are 7,359 tons, a decided increase on the 1,742 tons exported in 1934. Production was greatest in the Kwimba and Maswa districts which showed increases of six and five times respectively more than last year's export figures. An increase was also recorded in the Shinyanga district which exported 2,956 tons as against 842 tons in 1934.

69. A considerable increase was also recorded in the Western Province where exports rose from 4,555 tons in 1934 to 6,126 tons in 1935, most of the crop coming from the Tabora and Kahama districts. A sixty-ton crop was harvested in the Uha sleeping sickness concentrations, a notable achievement.

70. *Rice.*—The production of this important crop has been maintained in the lake shore areas in spite of the fact that cotton has ousted it from certain areas in the hinterland. A considerably increased acreage was planted in the Kigoma area and the quantity marketed is stated to be 1,729 tons, an increase of 536 tons over the previous year. Exports from the Lake Province amounted to 203 tons of rice and 1,507 tons of paddy and in the Western Province they rose to 2,463 tons of rice and 789 tons of paddy.

71. *Tobacco.*—The Biharamulo district is the only area in this circle where tobacco is cultivated extensively. Although the number of growers increased considerably this year, there was no corresponding increase in production on account of indifferent weather conditions.

72. *Sesame.*—This crop is of minor importance. Attempts to better the quality by importing improved seed have had little success.

73. *Root Crops.*—The cultivation of the sweet potato and cassava crops has been encouraged in the last few years and as an anti-locust measure and insurance against famine, their value cannot be over estimated. A sound reserve of these crops has been built up in most areas.

74. *Cereals.*—Sorghums and millets are the mainstay of the population. Maize is of minor importance and is usually eaten in the form of green mealies.

Locusts have helped to increase the cultivation of quick-maturing varieties of sorghums such as *feterita* and the value of this sorghum as an insurance crop is becoming more widely recognized.

75. *Beeswax.*—Although the work of collecting and preparing beeswax was encouraged in all areas, unfavourable conditions have caused a decline in the export of this valuable product. Exports from the Lake and Western Provinces amounted to 5 tons and 174 tons respectively.

76. *Gum Arabic.*—Seven hundred and thirty-one tons of gum were exported from this circle of which six hundred and eighty tons were from the Shinyanga district.

Pests, Diseases and Vermin.

77. *Cotton.*—In March a heavy infestation of *aphis* in the cotton areas created considerable pessimism. In northern Maswa and Shinyanga cotton suffered from a severe attack of *jassid* and in the latter district considerable damage was done by stainers and American and spiny boll-worms. With regard to the "leaf curl" disease reported in previous years the assistant entomologist has come to the conclusion that "the cotton trouble which is apparent spasmodically in the lake shore area and has been previously referred to as leaf-crinkle, leaf-curl, virus, etc., is due to attack by insects of the *hemipterous* family *capsidæ*, in particular by a species of *lygus* provisionally referred to as *L. vosseleri.*" He also states that "injury to cotton by *lygus* spp., is under investigation in Uganda. The experience there is that 'intense *capsid* injury occurs during cold wet seasons; during moderately dry conditions the insect causes little trouble'."

78. Internal boll disease and boll shedding were the causes of the low yields obtained in Kahama, Nzega and Tabora areas and, although it has not been proved, it is strongly suspected that *Calidea bohemani* is responsible for the trouble.

79. The discovery of *Platyedra* spp. at the end of last year on kidney cotton plants in the Kigoma area resulted in this type of cotton being scheduled in the Western Province as a noxious weed under the Plant Pest and Disease (Cotton) Regulations; necessary steps have been taken to have all such plants uprooted and they are steadily being eradicated.

80. *Groundnuts.*—*Cercospora personata* and rosette disease were recorded in the Kigoma area.

81. *Cereals.*—The Agricultural Officer, Tabora, reports: "In the Tabora district, the incidence of stalk borer was abnormally high, and, combined with a short drought in January-February, caused much damage, particularly in west Tabora where maize and sorghums were in some cases (according to the time of planting) complete failures."

In areas where it is the practice to feed the stalks to cattle the incidence of stock borer tends to decrease.

Smuts and downy mildew were prevalent in sorghums and millets: the sulphuring of seed with a view to preventing and controlling grain smut has been continued. Much attention has been given to the eradication and control of *striga* and active anti-*striga* measures were carried out.

82. *Coffee.*—The pests of economic importance in Buboka are the coffee bean borer (*Stephanoderes* sp.) and the coffee bug (*Antestia* sp.). Control measures were carried out against *Stephanoderes* as in the two previous seasons and this year the incidence of this pest was less than usual.

83. *Cassava.*—"Leaf-curl" was common on all cassava plantations. Trials are being conducted with selections showing resistance to this disease.

84. Pigs, porcupines, baboons and rats caused the usual damage to crops. A successful campaign against baboons was waged in the Shinyanga district, very satisfactory results being obtained with the use of arsenical poisons.

85. While a certain amount of egg-laying occurred in the early part of the year, and some damage to crops occurred, the locust position was never serious.

Agricultural Shows.

86. Shows were held at Shanwa (Maswa), Ngudu (Kwimba) and Ukiriguru (Mwanza), and in each case were highly successful. They are very popular with the natives and from the educational point of view are of considerable value.

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Annexure III

ANNUAL REVIEW OF THE SOUTH-EASTERN CIRCLE.

The Southern Province.

General Remarks on Weather and Crop Production.

1. The year 1935 has been one of many vicissitudes and each district has its own story to tell. Produce prices showed a general improvement and a healthier tone has prevailed all round. After a series of lean years the marked rise in the price of sisal is particularly pleasing and a substantial increase in exports has resulted, a new high record being reached.

2. In the main coastal areas the rains were short and ceased suddenly in April with the result that the expected increase in the cotton crop was again not forthcoming. Unfortunately, also, the adverse weather conditions were coupled with a general lateness in the planting of all crops, and millets, maize and rice suffered accordingly. Thus, though there has been no actual shortage of food supplies for domestic consumption, there has been very little surplus either for export or to meet the annual demands from the sisal estates.

3. On the other hand, sesame, the most important native product on the coast, benefited from the prevailing conditions and the record output of 1933 was surpassed.

4. The groundnut crop was normal and as a result of increased plantings the export record established in the previous year was maintained. Beeswax, which will receive more detailed mention later in the report, is becoming increasingly important in the province and during the year under review attained over a hundred per cent improvement over the previous record. Finally, the fire-cured native tobacco industry in Songea definitely emerged from the experimental stage and 106 tons were produced as against 33 tons in 1934. It must be admitted, however, that preliminary reports from the department's brokers in Liverpool indicate that this increase may have been gained only with some sacrifice in quality.

Crop Production in Detail.

5. *Tobacco.*—The development of the fire-cured tobacco industry in Songea made rapid strides during the year as the following figures show :—

1932	...	...	...	1,897 kgs.
1933	...	...	...	6,537 ,,
1934	...	...	...	32,600 ,,
1935	...	...	...	106,045 ,,

As in previous years, the crop was purchased by Government and resold, after processing, as baled tobacco. By the end of the year the entire crop, amounting to 1,128 bales, had been shipped, 546 bales being consigned to brokers in Liverpool and the balance to manufacturers in Dar es Salaam. Preliminary reports from Liverpool regarding the earlier shipments have now been received and, though the tobacco has not yet been marketed, some anxiety is felt regarding the quality of the season's crop. Until the full reports are received no observations can be made, but there are indications that the tobacco has not the same light-brown colour as in previous years and approximates more closely to the Nyasaland product.

6. It must not be forgotten that with such a large influx of new growers the same detailed attention cannot be given to each individual and that, until they become more experienced, newcomers cannot be expected to produce the same uniform leaf as the older producer. Thus, as is shown by the following comparative table, the average cash receipt has fallen slightly :—

	1931	1932	1933	1934	1935
Number of growers	131	236	375	897	3,226
Average production (in kilos.) ...	7	8	18	36·25	32·78
Average cash receipt	2/56	3/40	8/63	16/61	14/36

It will be noted that the production figure per individual has also fallen slightly. This is largely due to the fact that the buying grades were severely tightened up and all thin trashy low-grade leaf returned to the producers. The crop remains popular with the growers who are well satisfied with their returns and are keen to improve their methods.

7. Two demonstration farms were maintained, one in each of the two tribal areas and, as in the previous year, the actual labour was carried out by tax-defaulters working in relays. The full amount of tax was again recovered by Government whilst the individuals concerned were fully instructed in each phase of tobacco cultivation.

8. The large number of new growers necessitated greater provision for the raising of seedlings, and altogether 12,000 yards of nurseries were prepared at forty centres, supplying young plants to 1,390 approved applicants. In addition, the policy outlined last year was carried into effect and 1,836 selected growers in the established areas were issued with seed and prepared their own nurseries. For the 1936 season the government nurseries have been reduced to eight in number, containing 3,000 yards of beds, and are mainly for demonstration purposes and as an insurance against individual failures. Four thousand eight hundred and six natives were issued with seed for planting in their own nurseries after the sites were approved.

9. *Marketing.*—As foreshadowed in the 1934 report, the time has now arrived when the industry has become sufficiently developed and established for it to be taken out of the hands of the department and transformed into a commercial undertaking. To this end plans have been drawn up for the establishment of a co-operative union. By the end of the year the necessary number of primary societies had been formed and had applied for registration and it is intended that the union itself shall be registered in time to purchase and handle the 1936 crop. This does not mean that thereafter the department's activities will be concerned only with the technical side of tobacco production. The union will be in need of constant advice and assistance, particularly in its infancy. It is expected, moreover, that when the union has settled into good running order it will be in a position to handle other of the products of the district, notably coffee and beeswax. Provision has been made in the bye-laws for such an eventuality.

10. *Masasi.*—Some five hundred natives in the Masasi district were issued with seedlings of Heavy Western tobacco but adverse climatic conditions negatived whatever success might otherwise have been obtained. As against five tons in 1934 a total crop of 2·7 tons was produced and sold to a manufacturer in Dar es Salaam. The experiment of tobacco growing in Masasi is not to be continued. The population of the district has already a liberal variety of economic crops and it is considered that the poor quality of the tobacco

which has been produced so far is liable to prejudice the good name of the Songea product.

11. *Sesame.*—This crop is easily the most popular amongst native cultivators and comfortably maintains its place as the most valuable item of native produce exported. During the year approximately 4,373 tons, valued at £46,972, were exported from the province.

12. *Grain (other than Rice).*—The grain crops have had a poor season. The year 1934 was one of abundance and at its close there were still considerable stocks in the hands of the people with the result that preparations for sowing were almost everywhere delayed. Then the rains ceased early. The fields were patchy and only light yields were obtained. Thus, though there has been no actual shortage for internal consumption, there has been little available for sale and export. Almost the whole of the 3,700 tons of grains which were exported were shipped during the first four months of the year, i.e. a carry-over from the 1934 crop.

13. In the Songea district conditions were more favourable and normal crops were obtained. Increased acreages were planted of eleusine and wheat and the latter especially gave good returns. Almost the only outlet for the wheat crop is by sale to a mission which possesses milling machinery and supplies flour to all its branches in the diocese. The supply is now becoming greater than the mission can absorb with the result that the tribesmen are themselves beginning to consume wheaten flour.

14. The reserves of root crops, particularly cassava, are not yet considered sufficient to meet any severe emergency. Increased plantings have been secured in many areas but the position cannot yet be regarded with equanamity.

15. *Rice.*—Rice suffered more than any other crop from the shortness of the rains and was a virtual failure. Again such export as took place represented only the carry-over from the previous year.

16. *Beeswax.*—Another phenomenal rise in the production of beeswax has led to this item rising to second place in importance as a native product and 272 tons, with a value of almost £23,000, were shipped during the year. This is double the previous record. It is gratifying to find also that the quality is steadily improving. For some time past the local product has been regarded unfavourably by the larger exporting houses in Dar es Salaam who were eventually compelled, if they wished to handle the product at all, to bring it to Dar es Salaam and there to purify it. In the year under review almost half the total quantity exported was shipped to European markets direct from Lindi.

17. Bee-keeping is receiving increased attention by the department, particularly in the Lindi and Masasi districts. In Lindi sixty-four model "Tanganyika" hives, fitted with queen excluders, were constructed and erected in suitable areas for demonstration purposes. In Masasi one instructor is maintained from funds supplied by the native treasury and is employed exclusively in demonstrating the use of the queen-excluders, showing the people how to produce clean wax and encouraging the industry generally. Under his supervision one hundred excluders were distributed during the year and fitted in "Tanganyika" hives.

18. *Groundnuts.*—In the coastal area, despite adverse conditions, the substantial increase in groundnut production recorded last year has been maintained. Had the weather been kinder a new record would undoubtedly have

been set up as larger acreages were planted throughout. The crop is also becoming increasingly important in the Songea district and 350 tons were sold locally. It is interesting to note that the oil is expressed and used locally as fuel for a Diesel power plant.

19. *Copra.*—The copra industry remains stagnant. Kilwa alone shows any appreciable production.

20. *Cotton: Coastal Area.*—Except in the Kilwa district and to some extent in Masasi, efforts to interest the people in the cultivation of cotton have met with little success, and it is expected that some years will pass before any important increase in the production of this crop can be anticipated.

21. The supplies of seed obtained from the 1934 crop were insufficient to meet requirements and what seed there was was of poor quality and with a low germination. The opportunity was, therefore, taken to effect a complete substitution of seed.

22. As in previous years the crop was purchased by the local ginners. Prices were promulgated by the Director of Agriculture and the following table shows the sales of seed-cotton by natives during the season :—

DISTRICT	Seed-Cotton (Native) in Pounds				Value received by Grower
	1st quality	2nd quality	3rd quality	Total	
					Shs.
*Lindi	172,100	12,800	35,500	220,400	18,400
Masasi	78,985	13,505	28,270	120,760	8,347
Mikindani ...	66,009	180	9,445	75,634	6,028
Tunduru	36,612	317	1,443	38,372	2,551
Kilwa	324,720	7,260	44,440	376,420	31,554
Total ...	678,426	34,062	119,098	831,586	66,880

* Lindi figures are estimated, as buying is not yet concluded.

The above compares with a total of 862,071 pounds with a value of Shs. 68,582/- in 1934, but the figures call for a little explanation. The Lindi and Mikindani districts have produced roughly only one-half and one-quarter respectively of their 1934 output. Masasi on the other hand has almost doubled production. The approximation between the total figures for the circle for the two years is almost entirely due to a very substantial increase in Kilwa. When it is remembered that no cotton at all was produced in this district in 1933, the rise from 60 tons in 1934 to 171 tons in 1935 represents a very creditable effort on the part of all concerned.

23. The production of cotton by non-natives increased from 50,074 to 124,568 pounds with an approximate value of Shs. 9,000/-. This was mostly interplanted in young sisal.

24. *Cotton in Tunduru.*—The attempt to reintroduce cotton into the Tunduru district is proving successful, and sixteen tons were produced in the year under review against one and a half tons in the previous season. No attempt is as yet made to "push" the crop nor is seed being issued over a wide area, distribution being confined to the vicinity of Tunduru itself. For the 1936 season seed of U4-920 cotton, imported from South Africa in 1934

and multiplied at the Mpapura station in 1935, is being issued to the exclusion of all other types.

25. *Cotton in Songea.*—A further effort to introduce cotton growing on the shore of Lake Nyasa is to be made in 1936 and ten tons of seed have been supplied from Nyasaland for the purpose. Three African instructors, with special knowledge of cotton growing, have been transferred from the coast to encourage and advise the local people. It is intended that the resultant crop shall be purchased and handled by Nyasaland ginners and eventually exported through the port of Beira. Cotton is grown very successfully on the Nyasaland shore of the lake and should do equally well on the Songea side in the limited area which is suitable. The people are keen but will have to be restrained from expanding inland from the shore and attempting to take their cultivations up into the foothills.

26. *Coffee.*—The cultivation of coffee is confined to the Umatengo division of the Songea district. Two tons of parchment coffee were produced by natives from the old original plantings and were disposed of locally at the rate of fifty cents of a shilling per kilogram. As production increases some marketing organization will have to be evolved. At the moment it is anticipated that the Songea Co-operative Marketing Union, established primarily to handle the tobacco crop, will be able to undertake this task.

27. The Agricultural Assistant (Mr. A. E. Twells) reports as follows:—

"Nurseries were prepared at six centres in the Matengo area, during the latter end of 1934, and 35,000 seedlings are now ready for distribution to approved growers. Further nurseries were laid down by responsible natives at twenty-two minor centres, and 70,000 seeds of Kent's hybrid coffee were issued, after the nurseries had been approved.

"Two hundred and thirty growers were issued with seedlings from the previous year's nursery, and a total of 17,551 seedlings were planted. Excepting in one area where die-back was experienced, the plantings have made excellent progress. The die-back was mainly caused owing to the fact of the seedlings having had a long transport from nurseries, and it was necessary to cut the young trees back which retarded their growth in that particular area.

"Contour terraces were made in every approved coffee garden, and planting sites were prepared nine months before the coffee was planted and put to a green crop.

"No government nurseries have been laid down for the coming season but seed has been issued direct to 355 approved growers at the rate of 300 each.

"Demonstration coffee nurseries were laid down by the Roman Catholic missions at twelve schools, and 200 seeds have been issued to each school. These nurseries are subject to the native authority rules, and are under the control of the department."

28. The development of this small but important industry is not being hurried or pushed forward. The people themselves are keen and intelligent and propaganda for further plantings is neither required nor desirable. It is a condition prior to the issue of seed or seedlings that every new grower shall be permanently resident in the area and that the proposed site of both nursery and plantation shall be approved. Thus the industry is being built up only by the addition of selected growers who are expected to give the constant and detailed attention which this crop demands.

29. The only non-native coffee estate in the district produced its first crop during the year and one and a half tons were exported. A small factory has been erected.

30. *Sisal.*—One of the most pleasing features of the year has been the marked improvement in the price of sisal and, after a series of lean years, estates are at last working at full pressure and are in a position to carry out regeneration and development programmes. As was to be expected, exports have exceeded all previous records as the following comparative table shows :—

	1933		1934		1935	
	Tons	Value £	Tons	Value £	Tons	Value £
Mikindani ...	1,942	22,810	1,986	23,032	2,482	37,285
Lindi ...	5,876	66,250	6,374	63,724	8,172	116,741
Totals ...	7,818	89,060	8,360	86,756	10,654	154,026

These figures do not include the considerable shipments which are made periodically from Ruvu Bay, the export entries in respect of which are passed in Dar es Salaam.

31. The Agricultural Officer, Lindi, records the following trials and observations on cover crops on the estates of Messrs. Mkoe Sisal Plantations, Limited :—

> "Locusts destroyed the cover crop observation plots which were planted in old sisal, but the replication of these in young sisal escaped damage. The only species which was at all successful was *Canavalia ensiformis*, which gave a consistently good stand throughout. *Crotalaria striata* failed to establish itself. A local indigenous *Crotalaria* produced a very patchy stand and did not make much growth. Bonavist beans and velvet beans both gave a fairly dense cover in patches but were irregular. Pigeon peas did not thrive. About sixty hectares of the estate are now under *Canavalia ensiformis*, and the manager states that the area under *Canavalia* required one weeding less than the rest of the sisal."

Experimental Stations.

32. The main work carried out at the Mpapura Experimental Station was the multiplication of the 500 kilograms of U4-920 cotton seed introduced from Barberton, South Africa. The season was unfavourable and only 10,260 pounds of seed-cotton were harvested which, after ginning, has provided some three and a half tons of seed for distribution in the Tunduru district.

33. Sesame trials were carried out to continue the investigations inaugurated by Mr. R. B. Allnutt, Agricultural Officer, in the previous year. The main result was to confirm that the seed of a normal plant is uniform in genetic composition and that white seed produces white seeded plants. As white sesame commands a premium of anything up to two pounds a ton over coloured or mixed types, a scheme for the wholesale substitution of white seed for the mixed supplies in the hands of the people has been devised, and the large-scale multiplication of such seed will be the main work to be carried out at Mpapura during 1936. Over four hundred acres have been cleared and prepared, and the scheme is being financed by the native treasuries in the province.

34. The old Mwera tribal farm at Mnacho in the Lindi district was used for the multiplication of U4-920 cotton. Sixty kilograms of seed produced 10,050 pounds of seed-cotton which in turn yielded approximately three tons of seed and this was also issued in the Tunduru district at the end of the year.

35. *School Gardens.*—The department assists and supervises the agricultural training given at government and mission schools wherever possible. In Songea the pupils at the Luhira Native Administration School were instructed in the planting and cultivation of food crops and tobacco, with satisfactory results. The gardens at Ndanda Mission and Lindi Government School maintained a fair standard of cultivation, orderliness and educational value, and rotations, seed selection, spacing and manuring were demonstrated.

Soil Erosion.

36. Erosion and methods to combat its ravages are becoming increasingly important in this province, as elsewhere in the Territory. So far no very comprehensive measures have been undertaken but demonstrations of contour ridging and weed lines have been made where possible. Of possibly greater ultimate importance are the efforts which have been made to interest the native authorities in the preservation of their land and the results are awaited with interest. There is at present so much available land that it is hardly surprising that the evils of erosion evoke but little unprompted interest.

Pests, Diseases and Vermin.

37. *Locusts.*—Flying swarms of red locust (*Nomadacris septemfaciata*) entered the district from southwards at the beginning of the year and passed through the province. Spasmodic egg-laying took place and a localized anti-hopper campaign was necessitated in the Masasi district. Many bands of hoppers became parasitized by *Empusa grylli* and failed to mature. The invasion took place before the crops were much in evidence and very little damage was done.

38. *Cotton.*—The Lindi-Masasi area reports a heavy incidence of pests and disease. Internal boll-rot and pink boll-worm were in evidence and a great deal of mildew (*Ramularia*). A certain amount of jassid damage took place. The U4-920 cotton was less affected by jassid but did not escape altogether. Both in the hopper and in the mature stage the elegant grasshopper (*Zonocerus elegans*) attacked many cotton fields in one area, defoliating the plants and reducing the yields to almost nothing.

39. *Tobacco.*—Wildfire, leaf crinkle and leaf spotting occurred on tobacco in Songea. Control measures were handicapped by continued humid weather.

40. The destruction of crops by game animals and vermin is still serious. Conditions are improving, however, thanks to control measures being undertaken by the staff of the Game Department, and during the year a large herd of elephant in the Masasi district was completely exterminated.

Conclusion.

41. The year which has passed has witnessed a further advance towards the economic prosperity of the people. The province is purely agricultural and there are no mining or industrial activities of any kind. Wealth can only be sought, therefore, either by tilling the soil or seeking work on the sisal estates and road works. Some crops have done less well than in previous seasons, others have exceeded all records, but on balance a net gain is recorded.

What is now required is a better equilibrium in crop production. Too many eggs are still placed in one basket. Thus the agricultural officer pertinently inquires: "What would Lindi have done if the sesame crop had failed?" When provision has been made for food supplies, the African tends to become a "one-crop man" with the result that he suffers from an unduly high proportion of lean years. It is to eliminate "cotton growers," "sesame growers" and such like and to substitute "farmers" that the special efforts of the officers of the department are being directed.

C. B. Garnett,
Acting Senior Agricultural Officer,
i/c South-Eastern Circle

Annexure IV

COFFEE RESEARCH AND EXPERIMENTAL STATION, LYAMUNGU, MOSHI.

I.—Administration.

Introduction.—In the 1934 report it was stated that that year was mainly one of preparation. To a great extent that statement is unavoidably true of the first nine months of this year.

As buildings and equipment became available for use, activities increased and, with the exception of one section, recorders and technical assistants, for whom considerably more training is necessary, the station was, at the end of the year, functioning smoothly.

Staff.—The Chief Scientific Officer, Plant Pathologist and European clerk were in residence throughout the year. The Entomologist worked at the Nyakato branch (Bukoba) for the same period. The Chemist reported for duty on the 23rd April from the East African Agricultural Research Station, Amani. The Agricultural Officer (Coffee) worked at the station until the 11th August when he proceeded on leave for the remainder of the year. The Agricultural Assistant (Plant Propagator) arrived on first appointment on the 24th January.

The Field Recording staff has been in a state of flux as was inevitable in creating a new service. Only two of the original probationers remain. It is proving difficult to obtain men of the right type. The lack of suitable recorders has been, and will be for some time, a limiting factor in the amount of work that the technical officers can accomplish.

Thanks are due to all members of the staff for their co-operation in building up the team spirit on which much of the success of an institution such as this depends.

Buildings.—The authorized programme of buildings, with the exception of the coffee factory, insectary and fumigatorium, is now complete.

The work of the technical officers was necessarily considerably handicapped until equipment was installed and power, gas and water made available. Electric light and power plant became ready in May but it required several weeks to fit up apparatus, most of which required electricity. Gas—"Silverlite" —was installed in June and water was turned on in July. Not until this date, therefore, could the laboratories be fully utilized.

Minor buildings for nursery and propagation work were first ready for use in May. Stores and workshops were taken over in July. The buildings provided are most satisfactory and this opportunity is taken to express appreciation of the work of the resident Senior Inspector of Works and of his unfailing efforts to assist.

Finance.—From the beginning of this year funds both for capital development and recurrent expenditure were under the sole control of the Chief Scientific Officer. The expenditure is analysed in Appendix I.

Board of Governors.—The second meeting of the board was held at the station on the 18th May when matters affecting work and development were discussed. Representatives from Kenya, Uganda and the East African Agricultural Research Station attended.

Development of the Station.—Steady progress has been made throughout the period in development of the lay-out of the site as an experimental station.

Gradually roads have been constructed, bridges thrown over water-courses, building "sores" healed, bush cleared, stumped and brought under annual legumes for the purpose of evening-up the land. It will require, however, a further rainy season to bring the station to the condition of neatness and orderliness that is to be expected.

The following table summarizes the position as to the lands opened up at the end of the year :—

Development of Station lands.

	Acres
Forests (to be left untouched)	30
Planted with coppices, wind belts, etc.	20
Felled, cleared, stumped and cultivated (of this forty-five acres are planted with edible beans and forty acres with other cover crops)	130
Nurseries	3
Experiments on coffee and collection of coffees	29
Roads, buildings and gardens	25
Paddocks	9
Unopened up, other than forests	64
TOTAL AREA ...	310

Meteorology.—The long rains were extremely heavy, amounting at the end of June to 61·3 inches.

Unfortunately the short rains failed and except for three storms, which precipitated about four inches, drought conditions prevailed for the remainder of the year.

The total for the year was 72 inches.

Thus whilst the season's weather favoured actual planting, it was quite against the successful establishment of young coffee.

It will be interesting to see whether coffee can be established in this area without irrigation, the latter being impracticable over a considerable area on the station.

The equipment for meteorological work is fairly complete, including autographic rainfall, temperature and humidity instruments. Atmospheric moisture is further measured by a whirling hygrometer, Piché hygrometer and wet and dry bulb thermometers. Soil temperatures are taken hourly at four depths in cultivated soil. A Jordan sunshine recorder has recently been received. Facilities are also available for wind measurements, including a Fuess anemometer.

Touring.—The Chief Scientific Officer was given the opportunity of visiting the main coffee growing areas of Uganda and Kenya and has thus in 1935 visited most of the coffee in East Africa. He also attended planters' days,

the Kenya coffee conference and the inter-territorial coffee conference at Nairobi, at the first conference reading a paper on "Variability in yield of *Coffea arabica*."

The Entomologist visited Kenya in connection with his introduction of parasites for the biological control of "mealy-bug."

Other members of the staff have travelled as necessary to carry out their duties.

Publications.—The Plant Pathologist published an article "Armillaria Root Rot in East Africa" in the *East African Agricultural Journal*, vol. I, No. 3 of November, and the staff collectively one on "Soil Erosion."

A paper by the Chief Scientific Officer, "Variability in yield of *Coffea arabica*," was published in the local press and in the *Kenya Coffee Board Bulletin*.

In August a circular, *Monthly Notes*, was issued for the first time with the object of adding to the means of keeping planters in touch with what the station is doing.

Pamphlet No. 15, "The Objects and Scope of the Coffee Research and Experiment Station," was published during the year.

Visitors.—The first meeting of the Tanganyika Territory Coffee Growers' Association was held at this station in July.

Visitors included His Excellency the Governor and party; the Acting Governor; Sir Malcolm Hailey, G.C.S.I.; Sir Alan Pim, K.C.I.E., C.S.I.; Mr. S. Milligan, C.B.E., C.I.E.; General Sir William Furse, K.C.B., D.S.O.; Major Sir William Lead, M.C., M.L.C.; the Directors of Agriculture, Tanganyika and Uganda; the Director of Medical Services; the Director of the East African Agricultural Research Station; the Director of Public Works; the Directors of the Veterinary and Tsetse Research; the Treasurer; Mr. P. Wyndham, C.I.E., C.B.E.; Capt. H. E. Rydon, M.L.C.; the President of the Kenya Coffee Board; Dr. J. Ruppel, Berlin; and Monsieur G. E. Sladden, Government Coffee Expert, Belgian Congo; as well as numerous planters.

S. M. GILBERT,
Chief Scientific Officer

II.—REVIEW OF THE YEAR'S WORK.

With the close of the year the Coffee Research and Experimental Station is functioning smoothly in its work of investigation of the immediate coffee problems.

As it is the only station of its kind in the Colonial Empire it may be claimed that for the first time in history coffee research has been placed on a sound footing in the colonies.

Briefly the objects may again be stated as an attempt to increase the productiveness of present and future plantings of coffee, taking into account yield and quality, the latter at present appertaining chiefly to size and appearance.

The results should be of value to all coffee growers, not only in East Africa, but elsewhere.

Work in other countries on other perennial crops has shown the necessity for certain basic knowledge concerning the crop before useful field experiments can be undertaken.*

Similarly in planning investigations on *Coffea arabica* attainment of this knowledge was a necessary foundation on which to build a programme of experiments.

It was required to find out the degree of variability of common field material and what factors influenced this variability.

They are being studied under two main groups :—

(a) Genetics—which includes the constitutional factor.

(b) Physiology—which includes the environmental factors.

Two further important groups are also under preliminary investigation :—

(c) Age.

(d) Season.

(a) *The Genetic factor—Selection.*—Individual tree records of cherry yield have been completed for the second season on over ten thousand trees situated in practically all the coffee areas of Tanganyika Territory.

Certain of these trees have been provisionally selected and the crop studied for such data as percentage clean coffee to cherry ; weight, length and size of bean, including a percentage of A's and peaberry.

These trees are carefully examined for influences of environment and ruthlessly excluded from "selection" if such factors give them undue advantages.

After several seasons it is hoped to discover "mother" trees that will answer satisfactorily the main tests for desirability in a commercial plantation.

To date some 250 samples of cherry have been studied. Not less than five pickings from one tree, when obtainable, are examined so as to obtain information on "time of picking."

As to yield in general over the two years it must be admitted that biennial bearing has been very prevalent. Last year's good trees have been this year's low yielders and vice versa even on the same plots. Only some five trees have yielded over four hundred ounces of cherry in both years.

Seasonal influence and the biennial bearing habit are thus shown to be problems of paramount importance.

Nevertheless pot culture experiments under carefully controlled conditions have proved that the genetic variability in the growth of seedling coffee is enormous.

It seems likely, therefore, that continued search will reveal trees with the constitution required.

(b) *Physiological factors—Experimentation.*—From observations on the recorded blocks it is obvious that soil, spacing, shade and similar factors have large influence on the growth and yield of seedling coffee.

Exact effects, in a preliminary way, were studied by means of sand cultures during the year.

With this experience available, work on a larger scale with clonal material in concrete boxes is commencing immediately. The boxes are large enough to grow *Coffea arabica* to bearing stage.

* Technical Communication No. 2—Imperial Bureau of Fruit Production.
Annual Reports of Cacao Research Schemes, Trinidad.
Tropical Agriculturist, LXXXV, No. 4, p. 198.

Generally speaking, however, investigations on the influence of factors of this group must be studied by means of field experiments. It is in this direction that results of immediate use to planters are likely to be attained.

The outcome of work to date is that knowledge has been gained as to (1) suitable plot size and (2) natural yields for two seasons.

It is thus possible after less than two years' work to apply treatments on certain of the more uniform blocks with the knowledge that reasonable increases in yield, due to the treatments applied, will be revealed and measurable. Natural yields for three years will be acquired for the other blocks.

This knowledge was fundamental to sound experimentation.

(c) and (d) *Age and Season.*—Research on groups (c) and (d) must necessarily occupy several seasons.

Vegetative Propagation.—This work is justifiable on several counts—

(i) in the improvement of existing coffee by "top-working" with buds and grafts;

(ii) for the propagation of good quality but non-vigorous coffees on vigorous stocks;

(iii) to enable precise experiments to be done on physiological problems by eliminating the variability due to constitution;

(iv) to produce clones of selected "mother" trees with the view to future mass production of desirable trees.

As a result of this year's work cuttings of certain types can be readily rooted in frames without bottom heat.

Work of this kind is only limited by the amount of suitable material available from the "mother" tree. Little is yet known of the means of inducing such material to form freely.

The technique of budding and grafting has so far advanced as to justify "top-working" preliminary experiments on estates.

The accumulated knowledge now gained is sufficient to warrant the lay-out of quantitative experiments on the best methods of extensive vegetative propagation in 1936.

Soil Work.—Useful progress has been made in the collection of soil samples on coffee estates with a view to defining the main soil types.

Investigations on dynamic factors, such as variation in nitrate content of various plots, have been commenced.

Leaf analysis with a view to finding diagnostic symptoms of plant food deficiencies has also been started.

Plant Diseases.—The Plant Pathologist has been engaged as necessary on all crops; on coffee in accordance with the agreement arrived at by the Board of Governors, an investigation on *Hemileia* was commenced as a major project, several field experiments on time, type and strength of sprays being laid out on a neighbouring estate. The advantages of spraying were fully confirmed in 1935. These experiments, amended as the result of field experience, continue.

Pest Control.—The Entomologist, apart from his work on other crops, has been mainly concerned, at the sub-station at Nyakato, in investigation of the factors causing natural control of "mealy-bug" in Bukoba.

A predator, *Schizobremia coffeæ*, Barnes, and two parasites have already been sent to Kenya for trial.

S. M. Gilbert,
Chief Scientific Officer

III.—Selection.

Aims.—Arabica coffee in an ordinary plantation, from seedling to full bearing stage, contains all sorts of individuals, good, indifferent and bad. Seasonal effects and other factors may make most of them bad.

The variability is enormous. The following tables illustrate this point on several characters :—

Table I.—Seedlings in Nursery in prepared compost beds.

Height of 1,040 Bourbon seedlings at October, 1935.
Planted in nursery from seed—October, 1934.

* Height in centimetres.																
5.5	8·5	11.5	14·5	17·5	20·5	23·5	26·5	29·5	32·5	35·5	38·5	41·5	44·5	47·5	50·5	53·5
† Frequency.																
10	17	32	32	98	68	85	120	93	111	135	88	87	36	22	5	1

Mode	35·50cm. (approx.)
Standard deviation	9·67cm.
Corrected estimate of mean	29·24cm.
Co-efficient of variation	32·87%

Table II.—Seedlings in Field.

Height in centimetres after six months.

	Mean height	Percentage
Large tops, large roots	23·50 ...	139·97
Large tops, small roots	21·25 ...	126·27
Average size—6 to 8 leaves ...	19·75 ...	117·68
Small tops, large roots	14·00 ...	83·38
Top cut back	12·25 ...	72·94
Small tops, small roots	10·00 ...	59·56
General mean	16·79 ...	100·00
Standard error	1·87 ...	2·80
Significant difference	1·62 ...	9·65

Seedlings selected for uniformity and planted in sterilized sand receiving identical food solutions and other conditions being the same, varied in height at six months from 23 to 38cm.

Table III.—Cherry yield in ounces per tree, 1934-35.

Yield class ozs.	Totals	Percentage
0— 50	3,938 ...	42·1
50—100	1,353 ...	14·5
100—150	906 ...	9·7
150—200	750 ...	8·0
200—250	653 ...	7·0
250—300	488 ...	5·2
300—350	344 ...	3·7
350—400	305 ...	3·3
400—450	240 ...	2·6
450—500	168 ...	1·8
500—550	90 ...	1·0
550—600	50 ...	0·5
600—650	29 ...	0·3
650—700	13 ...	0·14
700—750	11 ...	0·1
750—800	8 ...	0·08

*Middle height in each height class. †Number of trees in class.

Yield class ozs.	Totals	Percentage
800—850	6 ...	0·06
850—900	2 ...	0·02
900—950	2 ...	0·02
Totals ...	9,356 ...	100·0

Some of the trees are genetically bad and the most skilful of planters cannot make such trees good. In addition, constitutionally good trees can be made more productive by improvement of environment.

Among the millions of trees in East Africa there must be some that are eminently suited, because of their better constitution, to their environment. It is such trees, for which search is being made in respect to their yield, vigour and quality. Several seasons will be required in which to be certain that such trees are the best. Careful examination and ruthless elimination is necessary to ensure that influence of environment is discounted.

Work to date indicates that potentially high yielders do exist and a steady yield of one ton of clean coffee per acre seems within the realm of practical politics.

Indeed it may prove to be the case that environment and season are the limiting factors. That is, that many trees are inherently good yielders and the problem is to learn the field conditions necessary to enable such trees to give and maintain their best economic yield.

At this station, at present, yield and size are being given most attention. "Liquor" is being dealt with by the Biochemist of the Kenya Coffee Board.

Trees with desirable characters may, of course, be obtained by breeding. This work is in charge of the Geneticist, East African Agricultural Research Station, Amani, and the collection of coffees here is at his disposal. Further his hybrids are on trial at the station.

One of the main aims then of the research and experiments here is to obtain higher yields per acre—increased *productiveness—not* necessarily production—of coffee by the selection and propagation of good type uniform fruiting trees leading to decreased costs of production.

Methods.—In 1934 cherry yields of some thousands of trees, distributed on sixteen estates and holdings all over Tanganyika Territory were collected.

It was recognized then that the right criterion was weight of clean coffee of high grade per acre. Facilities and staff, however, were not available last year for such work.

In 1935 provision was made for investigations of yield from cherry to clean coffee.

Each recorded tree has its individual number. By arrangement with the planter, station recorders are present and weigh the crop from each tree at each picking. Samples of cherry from provisionally selected trees (1934 good yielders principally) and from plots are sent by the quickest means to the laboratory. There they are weighed, pulped and fermented under water until the mucilage comes away freely. After washing, the parchment is dried in the laboratory for three weeks and then finished off in the sun.

The method adopted is merely for the sake of uniformity of treatment. It is *not* suggested as a plantation method. The best methods are under investigation by the Biochemist of the Kenya Coffee Board.

Table IV shows the yield in cherry for 1935, for the estates on which the crop is finished, arranged as frequency distribution.

Table IV.

Frequency Class in ozs.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Totals	%
0— 50 ...	166	667	404	137	447		162	54	52	412	149	87	156	281	367	32	3,573	38·43
50—100 ...	28	71	71	54	133		157	80	45	122	188	29	376	179	225	44	1,802	19·38
100—150 ...	16	17	21	36	49		135	109	40	99	164	71	174	60	96	60	1,147	12·34
150—200 ...	9	8	10	14	35		127	122	25	71	103	131	18	16	40	93	822	8·84
200—250 ...	12	4	6	7	10		80	115	32	32	65	192	1	6	17	102	681	7·33
250—300 ...	8	2	1	4	8		59	116	29	11	28	129	—	—	2	109	506	5·44
300—350 ...	3	—	1	1	5		35	94	10	—	12	70	—	—	1	105	337	3·63
350—400 ...	1	—	—	2	1		14	64	3	2	1	27	—	—	—	88	203	2·18
400—450 ...	—	—	—	—	1		3	36	—	1	—	8	—	—	—	63	112	1·20
450—500 ...	—	—	—	—	2		2	27	1	—	1	3	—	—	—	32	68	0·73
500—550 ...	—	—	—	—	—		3	11	—	—	—	3	—	—	—	12	29	0·31
550—600 ...	—	—	—	—	—		—	5	—	—	—	—	—	—	—	5	10	0·11
600—650 ...	—	—	—	—	—		—	2	—	—	—	—	—	—	—	4	6	0·06
650—700 ...	—	—	—	—	—		—	1	—	—	—	—	—	—	—	1	2	0·02
700—750 ...	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
Total...	243	769	514	255	691		777	836	237	750	711	750	725	542	748	750	9,298	100·00

Crop failed

Data recorded.—It was aimed at obtaining samples from the selected trees on five occasions distributed equally over the picking period. In most cases the whole crop at one picking was taken as the "sample."

Among such data percentage by weight of clean coffee to cherry and of size (percentage by weight of beans other than "elephants" which will not pass through the largest sieve holes of the "sizing" screens) are of outstanding importance. Such figures provide clues to the trees which give the greatest return of first grade clean coffee. It is obvious that of two trees giving four hundred ounces of cherry per annum that giving 20 per cent clean coffee to cherry is more valuable than that giving only 16 per cent. At 530 trees to the acre (nine feet square) it is a difference of nearly five hundredweights per acre of clean coffee. If in addition there is a larger percentage of "A" and "P.B.s" or even of uniformity of size the resulting monetary return will, probably, again be enhanced. Further, in selecting "mother" trees the actual spacing in the plantation must be taken into account as it is yield of clean coffee per acre not per tree that matters.

Table V shows the variation in such data of some seventy-three trees studied :—

Table V.—(Taken from one hundred and twenty-six samples.)

Dimension	Lowest limit	Highest limit	Mode
Length per bean in mm. ...	7·7 ...	10·5 ...	9·4
Weight per bean in grs. ...	0·109 ...	0·218 ...	0·175
Volume per bean in c.cm. ...	0·09 ...	0·19 ...	0·165
Parchment to cherry	14·6% ...	30·5% ...	23·5%
Clean to parchment	54·5% ...	97·2% ...	81·0%
Clean to cherry	11·5% ...	24·1% ...	17·0%
Peaberry	— ...	37·3% ...	7·0%

The table is given in order to show the type of work being done rather than the results. The second year's crop in some of the blocks is still being harvested at the time of writing.

The results of the statistical examination of this material will be published in detail at the end of the third season when fuller opportunities of studying seasonal effects will have been obtained.

When "mother" trees are finally selected, they must undergo the acid test of the behaviour of their progenies in the field.

Vegetative propagation is inevitably a stage in the increase of such selections.

S. M. Gilbert,
Chief Scientific Officer

IV.—Vegetative Propagation of Coffee.

During the early months of the year little progress was made in obtaining rooted material vegetatively on account of the fact that propagation frames, potting sheds and tool sheds were not then erected.

A certain amount of budding was done, but to a very limited extent, for little suitable material was available, most coffee of suitable size having already been budded or grafted by Mr. Blaich of Sanya in the latter part of 1934. The buds which had "taken" among these were prepared for planting out in the field (i.e. pruning back the main stem and removing all growth from the stock) and were planted out in the museum plot in the rainy season.

Cuttings.—As soon as the propagation frames were finished different types of cuttings were inserted into sand, and a mixture of sand and leaf mould.

The frames are of the "Solar" propagator type modelled somewhat after the type used in Trinidad for the propagation of cocoa cuttings, being made of concrete three inches thick, the size of the compartments of the frames being three feet by three feet six inches and four feet deep. Drainage consisting of large stones was put in the bottom to the depth of one foot, and covered with a layer of leaves to prevent the rooting material sinking into the drainage. Concrete cases were made with the object of providing bottom heat for the frames by putting hurricane lamps in the cases and placing them in the drainage.

It was soon proved that bottom heat, under these conditions, was unnecessary—even detrimental. Cuttings rooted best in those frames heated only by the sun. It would appear that the best heat for the propagation of coffee by cuttings is about 25° centigrade. The heat in the frames is kept as even as possible by the application of shade in the form of "americani" cloth tacked close on the top of the glass and of green canvas raised to three feet from the glass. This is adjusted as necessary according to the heat of the sun.

Experience with frames so far gained goes to indicate that the best rooting medium is a mixture of sand and leaf mould, other materials so far experimented upon being plain sand, leaf mould, coconut fibre and mixtures of sand and leaf mould, and sand and coconut fibre.

Soft-wood Cuttings.—The type of cutting with the highest percentage of root (i.e. 100 per cent) was the soft-wood cutting, consisting of the tip of the upright shoot with two or three internodes, the bottom pair of leaves only, being removed. Certain types of coffee appear to root more readily than others, especially *Coffea arabica* var. Marajogipe and its hybrids, these rooting in about two weeks.

Once roots appear, the most satisfactory method to date is to transplant into small receptacles, such as clay pots or banana pots, using similar material as that in the frames plus a little ordinary soil. These "potted up" rooted cuttings are replaced into the propagator and gradually hardened off by giving a little more air each day for a fortnight, after which they are ready for planting out in the field under shade.

Hard-wood Cuttings.—Success has been obtained during the year with this type of cutting but rooting is much slower. Any period from three to about six months is required and the average rooting percentage is only fifty per cent.

The percentage of loss after transplanting of hard-wood cuttings is considerably greater.

For comparison the percentage of loss on soft-wood cuttings was approximately ten per cent whilst forty per cent of the hard-wood cuttings either died entirely or lost the roots they had made, it then being necessary to return them to the propagator to encourage new roots.

From experience so far gained in the vegetative propagation of coffee by cuttings, it appears that suckers taken from mature trees do not root as easily as those taken from unshaded stumped or layered plants. The reason for this is that suckers under heavy shade, such as that provided by the leafage on a large tree, are sappy and soft, and the distance between the internodes is often six times as long as the distance between the internodes of suckers taken from stumped or layered trees which are unshaded.

Where possible it is better to take cuttings early in the morning when the rate of absorption is still greater than the rate of transpiration. In the heat of the day cuttings wilt extremely quickly and, even when put into the moisture-saturated atmosphere of the propagating frames, take some time to recover.

Experiments are now being conducted to find more practical methods of vegetative propagation, which might be adopted by planters.

These experiments are still in their infancy, but, as soon as sufficient clonal material is available, they will be conducted on a larger scale.

This insufficiency of clonal material has been the greatest drawback in vegetative propagation this year, and different methods are being tried to obtain this material quickly, such as layering, stumping, etc.

Budding.—Fair success has been obtained in this operation and from fifty to ninety per cent "takes" have been recorded, according to the type and condition of the stock and the suitability of the buds.

So far it would appear that the most suitable bud to take is one with the "eye" just green and about to break. Dormant buds often take a considerable time to break and there are budded plants on the station which have been inserted for more than a year and the "eye," although still alive, remains dormant.

The main feature for success in budding, apart from the care taken with the operation itself, is to keep the stock moist at the roots. When this is done budding may be carried out at any time of the year, although probably the period just before the rains, when natural sap rise is likely to be great, is best.

Grafting.—Success in grafting coffee was not obtained until late in the year but now the difficulties have been overcome in cleft, rind and side grafting.

Here again the most suitable material for the scion is that in which the "eyes" are green and about to break. Under these conditions it is possible to see if the graft has taken about one month after the operation is performed.

Varying success has been obtained from grafts, from fifty to ninety per cent according to the type of coffee used both for stock and scion.

Lack of suitable material for stocks has been the determining factor on the number of grafts made, the most suitable size of stock here being those with a stem of over one inch in diameter. There is but one exception to this. During the year success has been obtained in a new form of graft for coffee, that is, grafting on to a cutting which is afterwards rooted as described above. For this method a stock of not more than half-inch diameter has been found most suitable.

Layering.—Etiolated suckers from layers have given roots. The chief drawback to this method is that it is much slower than that of cuttings as the wood of the suckers must be quite hard before etiolation. Plants have been experimented upon to find a quicker method. The most successful of these so far is to wire the stem of the sucker before etiolation just above the point where roots are required. Other methods tried were, ring-barking eighth-, quarter- and half-inch strips, splitting and inserting a small stone, and making an incision half-way into the stem.

Marcotting.—A little success has been obtained by this method but it does not seem to be very practicable.

The same methods were used as for layering and the wiring again gave the best success.

On removal from the main stem after rooting the percentage of loss is high and great care is necessary in transplanting.

In the main, the previous observations apply to *Coffea arabica* only. A few cuttings have been taken from other species of coffee, and of these, *Coffea robusta* seems to be particularly easy to root. When sufficient material is available of other coffee species, experiments will be made to find their suitability for stocks and scions, etc.

Miscellaneous.—A considerable amount of ornamental planting has taken place during the year, mainly from cuttings taken from a few plants already introduced on the station and from material obtained locally.

African pupils have been instructed in budding and grafting. Their capabilities for this kind of work seem considerable ; their grafts and buddings being quite successful.

C. B. Gibbins,
Agricultural Assistant

V.—Experimentation.

The highly variable character of the average coffee population in the sixteen blocks recorded has been confirmed for the second year.

Table VI gives the frequencies for the best, medium and worst estates in 1934 compared with their yield in 1935 :—

Table VI.

Class interval Ounces of cherry	A—best No. of trees in class		B—medium No. of trees in class		C—worst No. of trees in class	
	1934	1935	1934	1935	1934	1935
0— 50	25	667	207	162	734	367
50—100	18	71	169	157	1	225
100—150	37	17	148	135	1	96
150—200	38	8	105	127	—	40
200—250	77	4	78	80	—	17
250—300	96	2	43	59	—	2
300—350	99	—	16	35	—	1
350—400	129	—	5	14	—	—
400—450	117	—	4	3	—	—
450—500	77	—	1	2	—	—
500—550	32	—	—	3	—	—
550—600	18	—	1	—	—	—
600—650	2	—	—	—	—	—
650—700	1	—	—	—	—	—
700—750	2	—	—	—	—	—
750—800	1	—	—	—	—	—
Totals	769	769	777	777	736	748

The terms *worst* and *best* might perhaps be better described as "off" and "on" since seasonal effect is already seen to be large.

Table VII gives statistics for a period of five years for one estate only as an indication to this effect.

Table VII.

Year	No. of trees	Mean in oz. cherry per tree	Standard deviation	Co-efficient of variation	*Calculated yield per acre clean coffee cwt.
1931	600	21·9	19·6	89·5	3·6
1932	601	20·2	23·5	116·2	3·3
1933	607	104·4	78·2	74·9	17·2
1934	593	12·7	18·9	148·6	2·1
1935	542	49·9	44·8	89·8	8·2

Planted in nursery: 1928.
Planted in field: 1929.
Type of coffee: Bourbon.
Trees per acre: 1,600 (approx.).

The biennial bearing habit does not appear in the first two years of bearing on this estate. Note the effect on the 1934 crop of the abnormally heavy yield in 1933.

Table VIII summarizes the "constants" calculated for all the blocks recorded for 1934 and 1935 which again strikingly indicates the variability and the biennial bearing habit.

*Not taking into account vacancies and allowing 18·5 per cent clean coffee to cherry. This figure was obtained from representative samples for 1935.

Table VIII.

Estate	Year	Number of Trees	Mean yield in ounces of cherry per tree	Standard Deviation	Co-efficient of Variation
					%
A ...	1934	593	13	18·9	148·6
	1935	593	50	44·8	89·8
B ...	1934	780	41	38·12	92·7
	1935	780	205	99·19	48·3
C ...	1934	812	131	92·60	70·7
	1935	812	70	70·71	101·6
D ...	1934	780	47	30·30	65·1
	1935	780	78	34·60	44·2
E ...	1934	780	21	17·26	81·4
	1935	780	269	125·47	46·5
F ...	1934	780	120	91·10	75·7
	1935	780	140	99·06	70·7
G ...	1934	246	103	94·64	91·7
	1935	246	144	98·42	68·4
H ...	1934	255	228	173·13	75·8
	1935	255	66	68·44	102·4
I ...	1934	517	186	134·51	72·2
	1935	517	35	44·10	125·7
J ...	1934	797	145	123·95	85·4
	1935	797	56	65·53	116·2
K ...	1934	777	136	106·01	77·8
	1935	777	Crop failed	—	—
L ...	1934	780	123	94·90	76·8
	1935	780	117	75·10	64·3
M ...	1934	803	328	126·96	38·7
	1935	803	24	35·07	143·4
N ...	1934	241	417	213·50	51·2
	1935	241	64	81·76	128·2
O ...	1934	780	5	7·50	156·4
	1935	780	65	52·26	80·5
P ...	1934	384	143	104·50	73·0
	1935	884	231	125·04	54·1

The above figures are all of cherry yield. Reduction to clean coffee was carried out in 1935, but in order to utilize two years' figures the adjustments are not included in this section. There is no reason to suppose that variability will be less on clean coffee yields.

In 1934-35 yields of individual trees varied from nil to 960 ounces; in 1935-36 from nil to 636 ounces.

The variation indicated above can only be due in any one season to one or more of three groups of factors—genetic make-up, environment and age.

The problem in experimenting with coffee is to devise, if possible, methods of lay-out which will enable the influence of these groups of factors to be measured and their affect cancelled or minimized.

Under environment is included soil as an important constituent factor.

The method chosen in studying these factors is to apply the same latin square lay-out of four by four plots, with double guard rows, to the blocks on which individual tree records are being kept.

The number of trees was so selected that plots with a maximum of twenty-five trees could be marked out. Briefly the number of trees per plot may be decreased so long as the variance due to error does not increase unduly.

Such a lay-out enables the research worker to estimate the amount of variance due chiefly to (a) soil factors, (b) experimental error and (c) treatment.

In a "uniformity" trial treatments are not applied and the variance obtained under this head is chiefly an indication of the degree of mixing of the plant material being utilized, soil differences being eliminated mainly by "rows" and "columns." If "treatment" figure is low it means that good and bad trees are well mixed, which is, of course, desirable if future experiments are to be laid out on these plots. Usually "treatment" and "error" variance may be grouped in a "uniformity" trial for calculation of a new standard error.

For the benefit of the layman a typical latin square is given as an illustration.

As far as possible blocks were selected for trees of even growth and of the same age. Age also appears to have a large effect on variability.

Fig. II.

A	C	B	D
C	D	A	B
D	B	C	A
B	A	D	C

Sixteen plots—4 × 4.

Letters indicate treatments.

No one treatment appears in any row or column more than once.

Tables IX (a) and (b) summarize the analysis of variance for two years on two estates as an example. This has been done for all estates for 1934. The figures for 1935 have not yet been completed :—

Table IX.—(a) *Estate F.*

1 Trees per plot	2	3 1934	4 1935	5 1934-35
20	Mean in ounces	111·8	142·8	127·3
	Standard error, per cent ...	23·8	37·9	25·3
	Percentage increase required...	38·2	60·7	40·4
16	Mean in ounces	111·6	146·1	128·9
	Standard error, per cent ...	26·9	35·2	25·4
	Percentage increase required...	43·0	56·3	40·6
12	Mean in ounces	112·9	149·9	131·4
	Standard error, per cent ...	29·1	28·3	21·1
	Percentage increase required...	46·6	45·2	33·8

(b) *Estate O.*

1 Trees per plot	2	3 1934	4 1935	5 1934-35
20	Mean in ounces	3·2	63·1	33·1
	Standard error, per cent ...	89·9	31·0	31·8
	Percentage increase required...	143·9	49·7	50·9
16	Mean in ounces	3·3	61·0	32·2
	Standard error, per cent ...	93·6	31·6	32·0
	Percentage increase required...	149·8	50·5	51·2
12	Mean in ounces	2·9	57·2	30·1
	Standard error, per cent ...	106·0	41·8	41·3
	Percentage increase required...	169·5	66·9	66·0

The following notes explain the conclusions drawn therefrom.

In column (1) is given the number of trees per plot.

Column (5) gives the mean of 1934 and 1935 crops.

It will be noted that on estate F the standard error increases gradually in 1934 as the size of plot decreases. The converse is true in 1935. There is really little to be gained in this case by having plots of more than twelve trees provided two years' natural yields are taken. By doing this the percentage increase over the mean that can be demonstrated is reduced from 46·6 to 33·8 per cent.

Estate O demonstrates extreme biennial bearing. Due to this habit the use of 1934 results do not aid precision. The sixteen-tree plot appears to be large enough but only increases of the order of fifty per cent will be significant.

These investigations will be fully discussed in a separate publication.

Another method of increasing precision, that of co-variance, has not yet been studied.

From table X can be seen the percentage increases that would have had to be obtained from any given treatment over the mean yield per tree to have shown up on the variable coffee population on these blocks.

Only on one block in 1934 would increases of less than thirty-three per cent have been apparent.

Table X.—1934.

Plot	Trees per plot	Increase required (as percentage of mean yield per tree)
F	16	39·95
O	16	103·42
E	16	54·05
C	16	84·90
M	16	18·91
K	16	48·00
L	16	62·35
D	16	33·44
B	16	44·04

So far it is seen then that the average population of a coffee holding is not very suitable material on which to carry out field experiments for the purpose of testing the value of potential improvements in practice.

Fortunately there may possibly be a few treatments which can be expected to give sufficiently large increases to show up on an average estate, for example, mulching. Also where there are pronounced shortages in the soil of essential plant food, application of the appropriate manures may give such increases. As an example may be mentioned the increases of a hundred per cent in yield in cacao on certain soils in Trinidad due to the addition of phosphate. It is possible that similar conditions may be found in Tanganyika Territory as the result of the chemist's soil analyses.

Again a further method of increasing precision on such variable crops is also available, that of using previous years' records of natural yield for comparison with experiment yields.

One important achievement to date is the accumulation of such data on sixteen estates and holdings for two years and on a further four for one year.

With these figures available it is possible to show up the result of treatments giving a smaller order of increase.

Thus we are now in possession of data which will enable us to carry out several experiments on ordinary estates on which improved treatments may be compared with good possibility of obtaining demonstrable results.

Two such experiments have been laid out to date and arrangements have been made to conduct a further seven in the new year.

To summarize, at the end of the year, by means of the individual tree records which fortunately were commenced in June, 1934, soon after the station staff arrived, much is known as to (a) size of plot (number of trees) to be used, (b) likelihood of experiments being successful on an average estate without previous records and (c) are in a position to carry out some nine experiments on estates immediately.

In addition to experiments on estates several experiments have been laid down on the station where special precautions have been taken to ensure the greatest possible uniformity obtainable in seedling material. Details of these experiments are given in various *Monthly Notes* commencing with December, 1934.

Two of these experiments were laid down in 1934. One, on soil erosion, has given striking results. The details are contained in the *East African Agricultural Journal*, vol. I, No. 3, p. 236. Briefly a procumbent cover crop,

with hedges at intervals of thirty-three feet across the slope, practically stopped all erosion in young coffee on a grade of one to six and under a rainfall of forty-six inches. A clean weeded plot lost nearly five hundred times the amount of soil as that from a "cover crop" plot in one day under heavy rain.

The other, a cultivation experiment, has given no significant differences in growth on one year old coffee.

The 1935 experiments are not, of course, of sufficient age to give results although several points of minor but practical importance have emerged. For example, "ball" planting may be harmful if the shrinkage rate of the nursery soil is different from that of the field. "Holing" may be bad for the same reason. Roots were badly damaged in both cases on this station.

A further point of note is that in the close planting (five feet) of experiment XII *Crotalaria ivantulensis*, in a single line between the coffee, definitely wilted the young coffee in November before the short rains, whereas in the normal spacing (nine feet) of experiment I no ill effects were caused. Under the conditions at Lyamungu young coffee can withstand no competition for moisture with cover crops in the dry season.

In conclusion it may be pointed out that basic work as described above has been found essential in other countries on all tropical perennial crops as a preliminary to the planning of successful field experiments.

S. M. Gilbert,
Chief Scientific Officer

VI.—Soil Work.

The Chemist left Amani to come to the Coffee Research Station on the 19th April. It was necessary to be present for the final fitting of the new laboratory, a process which inevitably took many weeks. The essential services of gas, water and power were not all available until the end of July; consequently it was not possible to carry out certain lines of investigation in the field at the time of greatest flux, viz. during, and just after, the long rains.

Prior to transfer to Lyamungu, laboratory work was continued at Amani on soil samples collected for the extensive survey of East African soils which included representative soils from the main coffee areas in the Territory.

The general chemical properties of the main soil types were reviewed in the 1934 annual report of the department. Further material has recently been collected to include the areas of Oldeani, Babati and Kiru.

Survey data so far obtained may be considered fundamental in the sense of defining the main characteristics of the soil types. For the purpose of deciding how far soil properties influence economic production of coffee a more intensive survey was needed in order to correlate soil properties with actual levels of production. With this end in view, soil samples are being taken from all the plots on which accurate measurements of yield are being made.

Routine Station Investigations.—Studies on seasonal variation in nitrate production in soil have been commenced. The effect of different kinds of mulch on this factor will be observed at frequent intervals.

Coffee Problems.—(i) "Yellowing" and die-back. On some of the volcanic ash soils there appears a peculiar type of leaf symptom associated with serious die-back of coffee. Although various other causes may be responsible for this condition, one must not rule out the possibility of some chemical soil factor—a mineral deficiency, a toxicity or a lack of balance in mineral nutrition.

The possibility of toxic factors has been investigated by attempting to reproduce the peculiar leaf symptoms by immersion of coffee stems in solutions containing toxic concentrations of various ions, such as borate, nitrite, sodium, calcium, chloride and sulphate. In most cases, the leaves showed characteristic symptoms according to the ions present in toxic concentration, but in no case were the characteristic leaf symptoms, observed in the field, reproduced.

The possibility of a mineral deficiency is confined to that of some minor element, because the soils concerned are very rich in all the main plant nutrients. A survey of the manganese status of the main coffee soils of Tanganyika showed that these rich ash soils contain very much smaller amounts of exchangeable manganese and manganese dioxide than any of the other soil types. Further, leaves taken from affected trees contain appreciably less manganese than healthy ones in the immediate vicinity. The indication is sufficiently strong for experimental work to be undertaken to try and prevent the trouble by injection of a manganese salt into the trees employing the technique used at East Malling.

(ii) "Non-Fruiting Coffee at Mufindi." Advice has been sought as to suitable soil treatment to overcome the marked tendency to vegetative growth and lack of fruiting propensity which is common in Mufindi area. Soil samples collected from these have been examined. So far as work has proceeded it seems that there is a high level of nitrogen nutrition in proportion to that of mineral nutrition.

General.—Samples of whale oil soap manufactured locally have been examined and found to conform to the standards expected of such a product.

H. B. Stent,
Chemist

VII.—Report of the Entomologist—1935.

1. *Staff.*—The Entomologist, Mr. A. H. Ritchie, has been on duty during the year. The Assistant Entomologist, Mr. W. V. Harris, proceeded on vacation leave on the 19th June, 1935, and has attended the fourth Imperial Entomological Conference as representative of the Territory.

2. The Entomologist left Moshi in the Northern Province in January where he has recently been stationed and proceeded in travelling field laboratory to Bukoba. The Bukoba field station of the entomologist can be looked upon as an extension of the work of the Coffee Research Station at Lyamungu. Quarters and laboratory are provided from buildings on the lands of the Agricultural Training Centre, Nyakato, situated on the first coastal bluff 450 feet above and five miles distant from the town of Bukoba. Water has been laid on to the laboratory from the existing tower water tank which is fed by a hydraulic ram from springs. Requisite land is available around the laboratory for experimental coffee and insectary requirements.

3. *Visiting Entomological Workers in East Africa.*—The Entomologist had the pleasure of meeting Sr. J. Pinto da Fonseca of the Instituto Biologica, San Paulo, Brazil, when in Kampala working more particularly on the biology of *Heterospila coffeicola*, Schmeid. (Braconidæ), the external parasite of the grubs of *Stephanoderes hampei*, Ferr., *Prorops nasuta*, Waterst. (Bethylidæ), had been formerly imported to Brazil. The difficulty of maintaining a parasite population in the coffee areas of Brazil, it was explained, arises from the fact that the trees are fruitless for approximately six months of the year—a well defined crop period of arabica coffee solely—which of itself and combined with plantation sanitation measures holds down the Stephanoderes incidence to as low as three to four per cent crop. In the Bukoba coffee area, in comparison, arabica and robusta coffees are in mixed plantings and coffee fruit occurs and is leaving the port at all months of the year—this continuity of fruiting is contributory in giving Stephanoderes a steady succession of breeding material throughout the year. The most destructive incidence of Stephanoderes, I was informed, occurs in Brazil in the plantations in low, warm, humid valleys.

4. The other Brazilian worker, Professor Salvador da Toledo Piza of the University of San Paulo, was immediately interested in the parasites and predators of the Green Scale of coffee, *Coccus viridis*, Green, and information in correspondence was afforded on the lines of the 1934 report, paragraph 9; a meeting could not, I regret to say, be arranged. The visit of Sr. Fonseca has permitted the establishment of a most useful personal contact with an entomological worker in the most important coffee producing country of Brazil and our meetings provided opportunity for the fullest discussion of the insect pest problems of our respective countries.

5. Inquiry was received from the Ministry of Agriculture, Egypt, for information on the parasites of *Prodenia litura*, F., (*vide* 1934 report, paragraph 39). No work has, however, so far been possible on the parasites of this important pest. A further inquiry came from the Agricultural Research Institute, Coimbatore, South India, for parasites of the Cotton Weevil, *Pempheres affinis*, F., which has not been observed so far in the Territory. Since November, two workers (Messrs. Bianchi and Krauss) of the Bureau of Entomology, United States Department of Agriculture, have been studying the parasites of Trypetidæ from two locations in the Usambara mountains of our Territory.

COFFEE INSECTS.

6. *Leaf-miner.*—The work on leaf-miner of coffee referred to in the previous 1934 report, paragraphs 10 and 11, has been further studied in the Bukoba area, particularly from the side of parasitism. While it was stated for Kilimanjaro that *Leucoptera daricella*, Meyr., was responsible for the major damage and that *Leucoptera coffeella*, Guér., was less serious, here in Bukoba the predominant leaf-miner is *Parectopa aletreuta*, Meyr., sp. n. (MS.) (Lithecolletidæ), and the damage by *Leucoptera coffeella*, Guér., again takes second place. The Parectopa has not been observed in our coffee areas east of the lakes. It attacks foliage of coffees of the three commercial groups: arabica, robusta and liberica, and is also to be found in such wild Rubiaceous plants as of the genus Canthium. The mines of Perectopa are confined to the upper side of coffee foliage and are of a winding or serpentine form as compared with the blotch or blister type of the two Leucopteras. In preparation for pupation, the wider section of the runway follows the leaf-margin and pupation takes

place in a mined out channel in the parenchyma over which the cuticle contracts causing a marginal leaf-curl. No silk is produced in the pupation chamber (*c.f.* Leucopteras where pupation takes place beneath a white silken hammock). The larvæ of Parectopa can readily be distinguished from those of the Leucopteras by their bright yellow colouration and in that they do not show the prominent segmentation of the Leucopteras.

It is interesting to record that in the Bukoba area *Leucoptera daricella*, Meyr., breeds freely in the wild hosts *Pavetta Oliveriana*, Hiern., and *Pavetta ternifolio*, Hooker (Rubiaceæ), in the latter of which there is an interesting parasitism. *Leucoptera coffeella*, Guér., also has been reared in Bukoba from the common wild shrub *Mussænda arcuata*, Poir. (Rubiaceæ), which extends from West Africa indicating with other data the African origin of these two coffee Leucopteras. *Leucoptera* (*Crobylophora*) *daricella*, Meyr., is figured and discussed in Memoirs of the Department of Agriculture in India—Life Histories of Indian Insects : Microlepidoptera, vol. VI—by the former Imperial Entomologist, T. Bainbridge Fletcher. It is of note that *L. daricella*, Meyr., occurs in the leafage of the common decorative garden shrub *Plumbago capensis* which damage is shown in the Indian publication (*l.c.* plate LXVII).

7. Adverting to paragraph 20 of the 1934 report, high incidence of fruit fly (Trypetidæ) maggots in coffee cherry in the Kilimanjaro area, the following parasites have since been determined by Dr. Ferrière from this material : *Isurgus* sp. (Ichneumonidæ), *Microbracon* two spp., *Opius* sp. near *concolor* Sz., *Biosteres* sp. (Braconidæ), *Eupelmus* sp. (Eupelmidæ) and *Sphegigaster* sp. (Pteromalidæ). The Trypetids included *Ceratitis capitata*, Wied., *C. rosa*, Karsch., and *Tririthrum nigerrimum*, Bezzi, the three predominant species on this crop as formerly reported (1927-28 report).

8. While the 1934 report dealt particularly with insect damage to coffee aggravated by the dry seasons which had prevailed, mention should be made also of attack on the coffee cherry by Acrididæ, particularly by *Cyrtacanthacris tatarica*, L., and *Acanthacris ruficornis*, Sjost., which invaded plantations from the hot and parched grasslands and bush—a water craving.

9. Again adverting to paragraph 9 of the 1934 report—initial occurrence of *Asterolecanium coffeæ*, Newst., in Kilimanjaro area—this scale has again been identified during the year in two further districts of the mountain widely separated from the point of first occurrence. In one instance, twelve trees were infested and, in the other, one tree only. The precise manner in which this coccid has effected its somewhat late arrival into the Kilimanjaro coffee area is as yet without explanation. Isolated examples of the coccid *Cerococcus hibisci*, Green, on coffee have been submitted from the Northern Province. Only once—in Kilimanjaro, 1926—has this scale assumed a threatening attitude and fully demonstrated the toxic nature of its presence on coffee even in small numbers on twigs and trunk.

10. *Stem-borers.*—In the district of Bukoba, the West African *Bixadus sierricola*, White (Lamiidæ), clashes in distribution with the East African *Anthores leuconotus*, Pasc. Material collected for study during the year has proved to be all of Anthores but it shows that in the wetter conditions prevailing egg-laying and development is effected readily well away from ground level which is preferred under the lower rainfall conditions of Kilimanjaro. The pest on this account is not likely to assume the economic import in Bukoba as has been the case east of the lakes and under lower rainfall. The meteorological and cultural conditions favouring these two species will require further study.

West of the lakes, the flute-holing of coffee branch and stem growth is done by *Dirphya princeps*, Jord. (vide *Bull. Entom. Res.*, vol. IV), and with the lustier wood development which pertains generally and coffee under the multiple stem system, the condition is more happy than with *Dirphya usambica*, Kbe., and single stem system of culture in our eastern coffee areas. For information on the subject of Bixadus, one may here recommend "Les Borers du Caféier en Basse Côte d'Ivoire," by Mallamaire.

Chlorophorus carinatus, Aur. (Cerambycidæ), was found in the grub stage boring beneath the bark into the cambial tissues of coffee also attacked by Anthores and reared from Anthores stems in the laboratory. The more typically Central African *Apate monachus*, F., occurred in stems submitted from the recently opened coffee area of Bugufi, in the south-west of Bukoba bordering on the Belgian Mandated Territory. *Phlœbius pustulosus*, Gerst. (Anthribidæ), is still the subject of inquiry from our Northern Province coffee areas but the satisfactory and well distributed rainfall of the past year should liven up the trees from their attractive "deadness" and Phlœbius reassume its position in the culture of comparative unimportance.

11. Hargreaves in the *Bulletin of Entomological Research*, vol. XVI, p. 347, has stated: "There is very little doubt that the beetle (Stephanoderes) is indigenous to this country (Uganda) and that its original food-plants were wild species of coffee." During the year and following up the work already done in the Northern Province a beginning has been made in a study of the wild hosts of coffee pests in Bukoba area. The coffee bean-borer, *Stephanoderes hampei*, Ferr., was discovered breeding freely in the cherry of wild Coffea robusta growing in the Kantale Forest twenty-five miles north-west of Bukoba town, thus definitely confirming Hargreaves' former statement in the matter.

12. *The Mealy-bug Problem on Coffee.*—While contemplating a general consideration of this problem, it is considered initially convenient to set out the average monthly rainfall as registered at the Bukoba station for the twenty-one years ending December, 1930:—

Average Monthly Rainfall, Bukoba Station.

(Figures extracted from Appendix VI, Report of the Dept. of Agriculture, 1930.)

January	138·2
February	180·3
March	291·5
April	347·3
May	224·6
June	66·4
July	39·0
August	85·2
September	94·1
October	104·3
November	138·2
December	191·2
Highest annual rainfall ...	23,339·1
Lowest annual rainfall ...	1,553·4

13. The rainfall figures for Bukoba before me, from January, 1922, to December, 1935, show that in one month only (July, 1927) was no rainfall registered. The records also indicate that the major coffee areas are favoured by a very regular and ample rainfall with no annual recurrences of an accentuated drought period conducive of very heavy thrips outbreaks as is the case

in the Northern Province coffee areas during the period December-March—a critical crop period between the small or blossom rains and the major season rains. Examination of the records also shows that in most months there is a precipitation of an inch or more within some one or more of the twenty-four hour periods and such precipitations fall within a short period and are accompanied by strong driving gales from the north-north-east and sleet. Such gales have the effect of cleaning down absolutely or in considerable degree coffee infested by mealy-bug, particularly the side of the tree facing the direction of the gale. Especially is this so in the case of smaller trees, more recently established and the younger foliar bug colonies. It may be remarked that a gale of this description in late June ruined the Nyakato pot cultures of bug.

14. Since the discovery by the writer of *Pseudococcus lilacinus*, Ckll., in the Bukoba coffee area on his first visit to the area in 1926 and, as then commented, affecting the coffee in a very minor degree, the factors influencing this situation have been recognized as of considerable interest. Until this year under review, however, opportunity for closer study of the problem has not been possible with other problems of major importance to our coffee industry in other coffee areas calling for our attention. Workers on the problem elsewhere but without close acquaintance of meteorological detail have ventured the general suggestion that the favourable *lilacinus* position in Bukoba resulted from or was a consequence of the prevailing meteorological conditions. With the suggestion and after experience in the area, I am prepared to agree that these conditions do in considerable measure help the situation, but such studies as have been possible with the rest of the advisory and routine entomological work of the Territory to undertake show that certain important biological factors are also at play.

15. Whether *lilacinus* so far as Bukoba is concerned is an introduced pest is a moot point; suffice it at the moment to comment that in 1926 it was found (on critical examination of fifteen lots of material by Laing of the British Museum of Natural History and this collected throughout the affected area) in the area from north of the Kagera river just south of the Uganda border stretching southward over eighty miles along the thickly settled coastal ridge and inward over the uplands suitable to coffee, at altitudes varying from 3,709 to 4,700 feet—an area of distribution at least co-extensive with the Kenya *lilacinus* area of the time (*vide* Kirkpatrick, "The Common Coffee Mealy-bug in Kenya Colony," 1927, p. 6), and an area which may be considered a considerable one for a type of insect as mealy-bug and in an almost completely native section of the country. It is fair comment that were it an introduced pest, it certainly was not one of very recent date. While coffee export from Bukoba in the pre-war year 1913 was 403 tons, in 1926 it had mounted to 4,637 tons, an extension of the industry which in the case of coffee is chiefly effected by seed and seedlings from locally established nurseries. This extension, be it admitted, may have assisted to a degree in the spread of *lilacinus*. This side of the subject will receive further inquiry.

16. Of predators occurring on *P. lilacinus*, Ckll., in Bukoba, the following have been determined:—

Coccinellidæ:

Platynaspis marginata, Sic.
,, *salaamensis*, Wse.
Scymnus luteus, Sic.
,, undetermined (T.T.1148).

One never finds these Coccinellids, however, in such numbers or vigour as say *Chilocorus angolensis*, Crotch, in the *lilacinus* areas of Kenya.

17. A most effective predator taken on *lilacinus* was *Schizobremia coffeæ*, Barnes*—(Cecidomyidæ); the maggots of this Cecid while initially white become vivid turmeric before pupation which takes place in a white webbing laid alongside the mid-rib of the coffee foliage. As many as twenty Cecid pupæ may be found along a single leaf mid-rib. The maggots feed deep within the *lilacinus* colonies. Material of this Cecid was sent in the pupal stage to the Scott Laboratories, Kenya, in September, and the predator is breeding "reasonably well on potato sprouts" there—Notley in litt.

18. A further most useful predator of *lilacinus* is the caterpillar of *Aslauga purpurascens*, Holland (Lycænidæ). These caterpillars which present the conformation of a large size Lecanius scale reach a size of 6mm. wide and 9 to 10mm. long. They advance over the bug colonies and feed from below effectively dealing with considerable numbers of bug colonies. The diet of Aslauga is of the soft coccids generally. The caterpillars of *Eublemma scitula*, Ramb. (which occurs throughout Africa from Egypt to the Cape), is yet another predator here but also a general soft coccid feeder.

19. The dipterous larvæ of *Leucopis africana*, Mall. (Milichiidæ), have also been observed in the bug colonies but never numerously. The prevailing colour of this fly is grey; two prominent thoracic black stripes; while the abdomen is almost entirely grey, the first three segments are centrally black on the dorsum (*c.f.* Kirkpatrick, l.c. p. 64).

20. The most prevalent internal parasite of *lilacinus* here is *Anagyrus aurantifrons*, Comp. (Encyrtidæ), which has also been observed to be the controlling factor of *P. perniciosus*, Newst. and Willc., in our Arusha coffee area. *A. aurantifrons*, Comp., is also an effective parasite on *P. citri*, Risso, on citrus in South Africa (Munro in litt.). Further materials at the time of submitting this report await specialist consideration. Material of *aurantifrons* has been shipped to Kenya and, I am informed by Notley, has bred there. The material of *Eublemma scitula*, Ramb., sent at the same time to Kenya has failed to breed.

21. The importance of ants in mealy-bug problems wherever they exist or arise is admitted. Kirkpatrick (l.c. p. 37) has stated with reference to the Kenya *lilacinus* situation "were it not for this ant (*Pheidole punctulata*, Mayr.), it is scarcely too much to say that the mealy-bug would no longer exist as a serious pest of coffee in Kenya." His tests with poison baits, however, was "a record of complete failures" against Pheidole (l.c. p. 88). Comparatively, in California the Barber poison bait and its modifications has enabled citrus growers to deal with the now world-known Argentine Ant, *Iridomyrmex humilis*, Mayr., and the problem there, the problem of ant control in the groves having been solved, has been the introduction from abroad of beneficial parasites and predators, a local or natural supply of such being absent or of unsatisfactorily low numbers in the groves. In the problem of the citrus mealy-bug in South Africa Dr. B. Smit of the Union Department of Agriculture working in the Sunday's River citrus area has found the Barber bait to work with satisfaction against the ant *Plagiolepis custodiens*, Fr. Smith and the local predators and parasites have the situation in hand (*vide* Science Bulletin No. 125, "Study of the Citrus Mealy-bug and its Association with Ants in the Eastern Province," Dept. of Agric., Union of S.A., 1934).

**Vide* pp. 528-9, *Bulletin of Entomological Research*, vol. 26, pt. 4 (December, 1935).

22. In Bukoba the ant which is dominant is *Myrmecaria natalensis*, Sm., which attends mealy-bug and most soft scales. It is an ant of the mound building habit and the runways migrate from the main nest to considerable distance. In gardens, this ant eats into most flowering plants and vegetables and as to field crops it favours such succulent tissues as the pods of *Phaseolus vulgaris*, the petioles of sunflower foliage, etc. On certain wild plants as of *Erlangea duemmeri*, it feeds around holes worked in the leaves. Without the nursing care or sanitary attentions of Myrmecaria, which tree banding effects, mealy-bug colonies on coffee, etc., tend to diminish in numbers and vigour or break down entirely, an effect not in my opinion entirely ascribable to predator or parasite action. The reaction of Myrmecaria to poison baits has not yet been tested; in European-owned land in preparation for coffee, the Myrmecaria nests are dug into and most effective use is made of the painter's blow-lamp, a method also followed where ant colonies gain establishment in the established coffee. Another Myrmecaria, viz. *M. eumenoides*, Gerst., gives trouble in citrus and tropical fruit plantings in the Morogoro area, mound building at the base of the trees and scale colonizing.

23. To sum up on this phase of the subject, in East Africa, there are ample beneficial insect forms whose degree of efficiency is interfered with and lowered or nullified by ant activity and the effect of mealy-bug pests on our crops is considerably aggravated as a consequence. The present defensive method of tree banding for ant isolation from trees is a recurrent and expensive one. It appears to the writer that the abolition of the ant nuisance (something more than mere ant exclusion) by some inexpensive baiting or killing method applicable to or workable against our peculiar ant species is the end to be aimed at and it is clear that very much has yet to be studied and accomplished along this line. If biological control of mealy-bug is to attain to its maximum efficiency, the ant must surely go and go first. The unsolved question at the moment is—"How?" In our Bukoba area, the mealy-bug position causes no alarm at the moment; the introduction of *lilacinus*, however, to the Northern Province areas with the meteorological conditions prevailing there would be, in my opinion, most serious. It is doubtful, indeed, if at average coffee prices pertaining, the crop could bear a heavier pest and disease control budget.

My remarks on ant control and the not altogether satisfactory state of our knowledge concerning it are also applicable to the Green Scale problem, serious in certain of our areas during periods of low rainfall (1934 report, paragraph 9).

24. *Miscellaneous Coffee Records.—Zaprionus vittiger*, Coq. (Drosophilidæ), breeds prolifically in coffee cherry, particularly fruit of which the outer cherry has split. The presence of this fly is equally undesirable as a high Trypetid population (*vide* 1934 report, paragraph 20). *Xyleborus ægir*, Egg. (Scolytidæ), attacks coffee stems with wounds resulting from careless or rough pruning and left unattended as to anti-cryptogamic dressing. *Bostrychopsis villosula*, Lesne (Bostrychidæ), is occasionally found boring in dry coffee stems and major branches. It is not a pest of the living or strictly healthy wood. It is here particularly mentioned because of its being confused with the more important primary pest, *Apate* spp. *Schizonycha* sp. (Melolonthidæ) has been taken in the adult stage feeding at coffee roots but in numbers never serious. *Taurotagus brevipennis*, Gah. (Lamiidæ), is a doubtful stem borer of the year but coffee literature is already much too full of such spurious mere occurrence records.

25. Thanks to the equable and kindly meteorological conditions which

pertain, Bukoba area has produced in 1935, 10,882 tons of coffee (Arabica 3,409 and Robusta 7,473). It is conservative to estimate that from the present plantings the present production could be doubled, if not quadrupled, with reasonable cultural care and industry which, it is a matter of regret to record is almost lacking in the area. The annual loss of crop from such pests as Antestia and Stephanoderes must amount to very many thousands of pounds; the work of their control, however, may come later as a matter of finesse once the hoe and pruning knife have their rightful place and we can truly refer to a Bukoba coffee *industry*.

COTTON INSECTS.

26. An outstanding feature of the season has been the prevalence of Helopeltis damage ("chancre des tiges," *vide* Rev. Appd. Ent., Ser. A., vol. 23, p. 378) recognized by characteristic bark injury of main stem and branches and red rosette injury of boll walls. The damage has been fairly general. Early experience with the boll-weevil of cotton of the southern United States of America causes one to realize fully the extreme susceptibility of cotton flower and square to the slightest insect interference and it is suggested that attack by the less conspicuous hemiptera is responsible for much of the bad set and final yields which pertain in certain of our cotton areas, the larger pests like *Mylabris dicincta*, Bert., while more obvious of themselves, exercise little effect on the cotton crop. There has been a noteworthy recrudescence of the cotton weevil, *Apion xanthostylum*, Wagn., in the area peculiar to it—Morogoro—and this with pink boll-worm evidence go to show that attention to "dead-season" sanitation measures require to be again tightened up. The wild host of Apion, while much time has been spent in our search for it, has as yet evaded discovery; the pink boll-worm in the latitude of Tanganyika has but one alternative host, *Hibiscus esculentus*—the ochro or "bamia"—while incidence in the very ample wild malvaceous flora has so far not been observed. As was very early pointed out by the writer, larvæ of long æstivation do not occur under our conditions and, by strict between-season field sanitation, pink boll-worm need have multiplied to no great numbers until the major proportion of the cotton crop has been safely made—attention, of course, being assiduously given to the importance of early maturity as a major point in field selection of cottons for our pink boll-worm areas. Our Mwanza area (Lake Province) which is now the premier cotton producing area is completely free of pink boll-worm, thanks to the quarantine enforced in 1924 and its eradication effected.

27. The parasites attacking pink boll-worm in Tanganyika include—*Microbracon kirkpatricki*, Wilkn. (originally submitted to the Imperial Institute of Entomology from Morogoro in 1922, although not described until 1927); *Chelonus curvimaculatus*, Cam.; and *Brachymeria olethrius*, Waterst., the latter in the alternative host ochro only. The Apion weevil is parasitized by *Entedon* sp. (Eulophidæ) while the leaf pest *Sylepta derogata*, F., the leaf-roller is controlled by *Microbracon recessus*, Szep., *Apanteles sagax*, Wilkn., and *A. sylepteæ*, Ferr.

28. In our Western Province, a Platyedra was reared by the Assistant Entomologist from kidney cotton (*G. brasiliensis*) grown for many years by the natives along the Arab trade routes and was originally referred to as *P. cunctatrix*, Meyr.; it is now understood that this is an undescribed Platyedra. In his investigations in the Western Province, the Assistant

Entomologist has bred out *Plemyristis œnochares*, Meyr. (Lyonetiidæ), a pest which confines its attention to seed in mature cotton bolls as well as being a pest of other seeds including coffee.

MISCELLANEOUS PESTS.

29. *Sweet Potato.*—While *Cylas compressus*, Hartm., is the predominant species affecting this crop east of the lakes in the main body of the Territory, *C. puncticollis*, Boh., predomintes in the Bukoba area, while *C. formicarius*, F., is also to be found; these latter species in my experience occur only west of the lakes and do not come into the peculiarly East African fauna.

Irish Potato.—While the tuber moth, *Phthorimæa operculella*, Z., does not occur in the Territory, potatoes for domestic consumption from Kenya sources have recently been showing an objectionable incidence of the pest and protective action is being contemplated. *Epilachna hirta*, Thunb. (Coccinellidæ), has again caused serious defoliation in our potato areas of the Usambaras.

Sesame.—While this crop is not produced commercially in the Bukoba district, it is noteworthy that two wild sesamums—*S. angustifolium*, Engl., and *S. angolense*, Welw.—occur commonly throughout the pasture lands and the seed capsules of these are seriously attacked by the maggots of *Asphondylia sesami*, Felt (Cecidomyidæ), and the sesame web-worm *Antigastra catalaunalis*, Dup. (Pyralidæ)—*vide* 1925-26 report—is also abundantly present. Such wild reservoirs of sesame pests must prove an important factor in any future attempted cultivation of the crop in the Bukoba area.

During the year there have been two flights (April and November) of the "Nsenene" *Homorocoryphus vicinus*, Redt. (Tettigonidæ). These insects are in much demand as food by the native population that but little opportunity is left them for depredation of crops. The food of "Nsenene" consists of grasses and graminaceous crops, principally sorghum and eleusine.

Haltica pyritosa, Er. (Halticidæ), was submitted from Usambara and from Belgian Mandated Territory severely defoliating rhubarb. *Engytatus* sp. near *volucer*, Kirk. (Capsidæ), occurred in very great numbers in the Sanya district on tobacco badly attacked by mosaic disease.

Stomoxys nigra, Macq., and *S. bilineata*, Grunb., bred in numbers in damp yellowing grass beneath Sesbania stems carried out to plantation intervals after destruction by Argyroploce (*vide* 1934 report, paragraph 23). *Hippobosca capensis*, v. Olf., in season proves an exceedingly troublesome pest of dogs.

30. Acknowledgment is made to Sir Guy A. K. Marshall, F.R.S., Director, Imperial Institute of Entomology, and his specialist staff for assistance in identifications and to Dr. S. A. Neave, Assistant Director for assistance in literature and translation. We are also indebted to Messrs. F. Laing and W. H. Tams of the British Museum (Natural History) for their specialist services. Mr. E. W. Mason of the Imperial Institute of Mycology has kindly advised in matters of Myco-entomology. The Agricultural field staff of the department continue to take a most useful interest in the pest side of their work which I may assure them is much appreciated.

ARCHIBALD H. RITCHIE,
Entomologist

VIII.—Plant Pathology.

Routine.—I have been stationed at the Coffee Research and Experiment Station, Lyamungu, Moshi, throughout the year, and shall be on duty during 1936. On the 8th April the laboratory was ready for occupation, and by August electric power, gas and water supply were available. Two safaris were undertaken to the Usambara and Tanga areas, from 30th January to 23rd February and from 3rd July to 13th August.

Publications.—The following were published: Mycological Circular No. 4 (Kiswahili) on wildfire of tobacco, and a paper entitled "Armillaria Root Rot in East Africa" (the *East African Agricultural Journal*, I, 3, 1935 (five figs.). A memorandum on diseases of sisal was circulated in January. A paper on Ustulina root disease of cacao was submitted to the above journal at the end of the year.

I had opportunities to refer to plant diseases at planters' meetings at Tanga in February and at Lushoto in July.

Diseases of Crops: Coffee.

Coffee Rust Disease or Hemileia (*Hemileia vastatrix*, B. and Br.).—The investigation of this disease has been recommended by the Board of Governors of the Coffee Research Station as a major project to be undertaken at the station, and this recommendation will be proposed at the Amani Conference in February, 1936.

In Tanganyika the disease is of varying economic importance: in the Iringa Province it appears to be entirely absent; in the Usambara mountains it is seldom severe enough to justify the cost of spraying; in the Northern Province, however, it varies from mild to very severe, and as a rule spraying is advisable. This is an expensive operation and demands study of means of reducing costs and increasing efficiency.

Experiments with fungicides.—Two preliminary experiments have been undertaken in 1935 near Lyamungu at 4,400 feet elevation to find the most effective spray mixture under the prevailing conditions.

This first season of experimental spraying work has been rather exploratory in nature. Various difficulties were recognized or have come to light. The chief of these has been the choice of satisfactory criteria on which to base comparisons of the results of treatments. This is particularly the case in the time-of-spraying experiment.

The criteria used were the number of rust spots on leaves, selected at random, but which had been on the trees at the beginning of the experiment, i.e. in March. Twenty-five leaves on each of four trees in each plot were used. Each plot consisted of twelve trees, but these were so variable in growth, and there were so many blanks, that four trees per plot were as many as could be consistently relied upon. There was no field of young coffee available in the neighbourhood.

In the time-of-spraying experiment the extent of the error due to the falling of heavily affected leaves is unknown but is believed to be large. In the second experiment on type of fungicide it is considered that the criteria although not perfect are more reliable, as the spraying was done at one time and counts were made on the same days.

It is considered that the best criteria particularly for a time-of-spraying experiment will be the weight of crop on trees, the cropping capacities of which have been accurately recorded over a period of three years. This will avoid the errors which arise in counting leaf-spots. Such trees will be available for the season after the 1936 crop is recorded. Until that time the accuracy required is not obtainable.

Experiment I.—The objects of the experiment were first to compare the number of leaf-spots caused by *Hemileia vastatrix* after spraying according to the programme outlined in table XI. It was intended that the treatments should start in each of the first five months of the year; the January and February programmes unfortunately could not be carried out because of my absence on safari in the first month and because of heavy rainfall at the end of the second.

The lay-out of the experiment was planned by the Chief Scientific Officer: an area of coffee was divided into a latin square of twenty-five plots; each plot was itself a latin square of twenty-five, sixteen or nine sub-plots, according to the number of treatments: the programme started in April had three treatments plus control, and the May programme two plus control.

Table XI.

Spray treatment. Time (month) and strength (per cent)	Mean number of spots per sub-plot (100 leaves)	Standard error	Significant difference	Observations
1. March 1% + May ½%	3·12	43·3704	11·55	No significant difference between these three treatments, but each is better than 4 or 3.
2. March 1% + June ½%	9·88			
3. March 1%	10·64			
4. March ½%	31·92			Significantly worse than 1, 2 or 3, and better than 5.
5. Control	1561·64			Significantly worse than 1, 2, 3 or 4.
1. April 1% + June ½%	13·95	21·47	12·03	Significantly better than 2 or 3.
2. April 1%	32·45			No significant difference between 2 and 3, but each is better than 4.
3. April ½%	40·5			
4. Control	1620·80			Significantly worse than 1, 2 or 3.
1. May ½%	64·06	1·249	3·924	Significantly better than 2 or 3.
2. May 1%	70·8			Just significantly worse than 1 and better than 3.
3. Control	1647·3			Significantly worse than 1 or 2.

In table XI the mean number of rust spots per sub-plot (i.e. on one hundred leaves) is recorded for each treatment. The results show a very great difference in treated and untreated sub-plots. The relative values of full, half and double sprays are not consistent in the spray programmes started in March, April and May : in the sub-plots in which spraying started in March there is no significant difference in the results obtained with the double sprayings and the full spray, but all are better than the half spray. In the April sub-plots the double was significantly better than the full or half sprays, there being no difference between the latter two. In the May sub-plots the half spray, according to the figures obtained, is significantly better than the full spray ! indicating that the criteria on which the differences are based are at fault ; it would be more helpful to say that in this case as in April the full spray is not found to be better than the half spray.

As the criteria are not considered sufficiently accurate, no attempt is made to compare the results of particular treatments applied in different months.

Naked-eye observations on treated and untreated sub-plots, while they have no statistical value, are none the less of some importance. The sprayed sub-plots not only show relatively few spots on the leaves but (1) sprayed leaves persist for a much longer period on the trees, and the trees remain densely covered with foliage of a normal green colour, in contrast to the more defoliated and yellower colour of the unsprayed trees ; (2) the untreated younger leaves on sprayed trees are less susceptible to the disease than in the case of unsprayed trees ; (3) the young flower spikes are more advanced in healthy than in rusted trees. The effect on cropping could not be even estimated in the experimental trees, as the crop was small throughout.

Experiment II.—To compare the effects of various modifications of Bordeaux mixture and two proprietary compounds, one of which is a dust applied dry. The spraying and dusting was done on the 25th March. The eight treatments and the untreated controls were laid out in a randomized block with four replications of each. The plots were each twelve trees, four being used in making observations, i.e. sixteen trees (four hundred leaves) for each treatment.

The following were the plots and treatments :—

1. Bordeaux mixture 1·0 per cent plus linseed oil as a spreader.
2. Bordeaux mixture 0·8 per cent plus linseed oil as a spreader.
3. A proprietary dust containing copper, applied dry with a dusting gun.
4. A proprietary mixture containing colloidal copper.
5. Bordeaux mixture 1·0 per cent plus groundnut oil as a spreader.
6. Groundnut oil (1·0 per cent) plus a proprietary spreader.
7. Bordeaux mixture 1·0 per cent plus sulphite lye (0·75 per cent).
8. Woburn mixture.
9. Control, not sprayed.

Linseed oil was applied at the rate of 1oz. to each 1lb. of solids in the mixture, i.e. 10oz. in 5-5-50.

Sulphite lye is a waste product obtained from the concentration of the lye from the sulphite process of wood pulp manufacture.

In each plot the number of spots on a hundred leaves (four trees) were counted. Leaves were chosen at random from among those which had been on the trees at the time of spraying and were still attached. From the counts, the figures in table XII were computed.

Table XII.

Treatment No.	Mean number of spots	Mean difference between any two treatments	Difference divided by S.E. (112·62)	Observations
5	19·25	7·00	·062	Not significantly different from one another, but significantly better than 4, 3, 8, 6 or 9.
1	26·25	1·00	·0089	
7	27·25	6·00	·053	
2	33·25	741·50	6·58	
4	774·75	126·50	1·12	Not significantly different from one another, but significantly better than 9.
3	901·25	123·75	1·10	
8	1025·00	24·75	·22	
6	1049·75	501·25	4·45	
9	1551·00	—	—	Significantly the worst.

These results show that under the conditions of the experiment the best treatments are :—

Bordeaux mixture 0·8 or 1·0 per cent plus linseed oil as a spreader.
Bordeaux mixture 1·0 per cent plus groundnut oil as a spreader.
Bordeaux mixture 1·0 per cent plus sulphite lye as a spreader.

Much less successful than the above, although still better than the control, are :—

The proprietary mixture containing colloidal copper.
The proprietary dust containing copper.
Woburn mixture.
Groundnut oil plus the proprietary spreader.

The control plots show heavy infection. Naked-eye observations are the same as are recorded above under Experiment I.

Remarks on the above Experiments.—While handicapped by the unavoidable lack of suitable trees and the necessity for choosing criteria not free from errors, the outstanding result of the experiments has been to show the value of spraying in maintaining healthy foliage. This remark must be qualified by the statement that spraying results must largely depend upon environmental and seasonal factors.

Until crop records for individual trees are available for a period of at least three years, it has been decided to postpone further time-of-spraying experiments. The experience of the past year will be of great value in the planning and execution of experiments in 1936, and these will consist largely of further investigation of the type of fungicides and spreaders most effective in maintaining healthy trees. When field technique is more perfect costs will be taken.

No reference is made to the effect of the sprays on brown eye-spot, as that disease was negligible.

Resistant Strains.—A few trees on one plantation showed so little *Hemileia* compared with their neighbours that hopes are entertained that they may have some definite resistance to the disease. Cuttings have been taken, and are being propagated. They will be tested for resistance in the coming season.

A disease of coffee, tea, etc., at Mufindi and Dabaga.—As neither fructifications nor sclerotia have yet been observed in the fungus referred to in Mycological Leaflet No. 16, pp. 8-10, it is not yet possible to put a name to it. Only the small erect sterile bodies known as *gemmæ* relieve the general

mycelial nature of the fungus. The disease recalls that caused by *Sclerotium coffeicola*, Stahel, in Surinam, British Guiana and Trinidad, although there is no evidence that the fungus is the same.

Material received this year from the affected areas was not alive on receipt at the laboratory, and cultures could not therefore be established. A common sclerotial fungus, *Botrytis cinerea*, mentioned below has no connection with this disease. It is hoped to revisit Mufindi in 1936 and investigate the problem more fully. An experiment has been planned for the coming year, from which it is hoped to obtain data on the best strength of Bordeaux mixture to use in spraying against this disease, and also on the most satisfactory spreader or sticker, on which it is believed that successful spraying will largely depend.

Collar Dry Rot—a disease of coffee in the Usambara Mountains.—The following is a preliminary account of a disease which appears not to have been recorded previously. The name collar dry rot might be applied to it. It has been known since January, 1933, and it was brought to my attention in February, 1934. Eelworms had been suspected to be the cause, but that explanation was negatived when those found were identified as saprophytic species. Several lots of diseased material have been examined, and in no case have fungi been observed. There are, however, reasons for believing that the disease is originally caused by insects, which disappear in the first year.

The disease is as yet known with certainty only on two coffee plantations about ten miles apart in the east Usambara mountains. There is a certain amount of coffee grown between these plantations, but not showing any of the disease symptoms except in the case of an abandoned two-year old seed-bed. Only *Coffea arabica* appears to be susceptible. Other species including *C. robusta* are equally open to the trouble, but remain healthy. Five acres of robusta coffee now two and a half years old is still unaffected, although it was taken from a seed-bed in which arabica had previously been sown. The latter had shown mealy-bugs on the roots when transplanted, and later developed the disease, while the robusta showed only very few mealy-bugs.

Symptoms of the disease.—Attention is not attracted to affected trees until they reach an age of about sixteen or eighteen months. After that age interruption in the flow of sap can bring about yellowing, die-back or defoliation. The trees may break at the collar and fall over.

A characteristic feature of affected trees is the swollen collar. In the one plantation this is at ground-level; in the other the swelling is several inches below the soil surface. The latter condition is no doubt the result of original planting of the seedlings in saucer-shaped depressions which have subsequently silted up; the soil in the second plantation is of very fine texture. The bark at the swelling is thick and soft and has a ragged uneven surface. Here and there small parts of the bark are a bright red colour, the reason for which is not clear.

An affected tree is usually killed, but there are found quite a number in which the energy of the plant above the diseased area has been thrown into the development of lateral or adventitious roots. These frequently take over the functions of the old root system, maintaining the tree, even if prostrate, in a fairly flourishing condition.

In a longitudinal section, with the inner surfaces planed smooth the upper and lower limits of the diseased area under the swelling are defined by uneven grey margins, which shade off into the healthy tissue. Within the diseased area are a number of pockets of dry-rotted wood. These pockets incline

upwards from the outside to the centre; in the early stage of the disease where the swelling is still very small or not noticeable at all these pockets are said to contain a jelly-like substance. The affected zone occurs across the whole diameter of the stem. At distances up to two and a half inches above the upper margin, a few pockets of dry-rotted wood are occasionally seen running in from the margins for a distance of about three-sixteenths of an inch.

The section of bark and wood exposed when the stem breaks from the old root is very rough, but the stem end appears to dry and callus satisfactorily wherever new roots are established. This natural method of recovery is not, however, a solution to the problem, as new roots are developed in a limited number of cases and the fallen bush is at the best unsightly. It is of interest in indicating that whatever causes the disease or the continuation of the initial injury is slow and restricted to the area at the collar and does not spread upwards in the stem nor into the new root system. No cases of recent deaths or early disease symptoms have been seen by me.

There is a possibility that the disease starts at the outside of the bark and extends inwards, but more likely that it starts when the tree is young, and spreads outwards from the oldest wood at the centre or inwards from the cambium. No cases have been seen of a diseased margin and a healthy centre or vice versa. The evidence is that it starts when the plant is young, in the seedling stage.

A possible explanation.—The only organism associated with the coffee which is at all suggestive as the original cause of the disease is the seedling parasite, the mealy-bug, *Pseudococcus brevispinosus* (syn. *Bromeliæ*). This insect was identified by Mr. A. H. Ritchie, Entomologist, in 1926 on one of the two estates.

While it is still necessary to obtain proof, the indications that this insect is the cause are as follows: (i) The mealy-bug is recorded from one at least of the two estates affected and from no others. (ii) The insect attacks *C. arabica* in which species the disease is found, and apparently not *C. robusta* in which the disease has not been found. Infection at the seedling stage is suspected because (i) the earliest formed wood in affected plants is invariably diseased; (ii) plants left in the nurseries have been noted to have a very high infection, up to one hundred per cent; (iii) infection is spread fairly evenly throughout the estates, and there is no indication that it spreads from centres in the fields.

The number of mealy-bugs diminished greatly in the hot weather, January to March, 1934. It has not been found in sufficient numbers in 1935 to enable infection experiments with it to be carried out.

It is admittedly difficult to explain the continued reaction of the plant so long after the seedling stage at which time the original injury is believed to occur.

Control.—The resistance of robusta has decided one of the planters concerned to graft arabica on to that stock in the hope of thus overcoming the difficulty.

Until the cause of the disease is satisfactorily proved it is not possible to indicate more satisfactory control measures, but in view of the fact that the mealy-bug is not disproved as the initial cause, any measures which can be taken to control it should be carried out, e.g. establishing new seed-beds, and washing off mealy-bugs and ants from roots before transplanting.

Armillaria root rot.—This disease assumes importance in plantations under certain conditions, particularly where perennial woody crops are grown. The subject was described in the *East African Agricultural Journal*, vol. I, No. 3, of November, 1935.

Of some interest was the discovery of the sporophores of the fungus in July. They were found on dead forest stumps and roots in a plantation in the Usambara mountains and were described in the above article.

Decay of forest stumps.—In connection with the disposal of stumps and logs which persist in large numbers on some estates, thus constituting a danger in increasing the amount of root disease fungi, a small experiment was started.

Five three-foot logs of each of nine species of common trees were cut and weighed and left to rot under different conditions. The loss of weight after intervals is being noted; the degree of rotting and the general type of decay organisms will be studied during the coming year. So far it is clear that logs exposed above ground lose weight three to four times as quickly as logs below ground. This confirms the advice already given that very large tree stumps, such as Piptadenia, which cannot be removed without great labour, could be dealt with by removing the soil from their immediate neighbourhood, i.e. round the stem and along the roots. This enables them to dry, crack and lose weight, and so become more readily removed or burned later on. The addition of lime would assist decay of the wood.

Warty Disease.—This disease, already recorded by McDonald in Kenya, was observed in July and August in the Usambara mountains, and in the Arusha and Mufindi areas. The *Botrytis* associated with the disease has been identified at the Imperial Mycological Institute as a strain of *B. cinerea*, Pers. Both the normal conidia and microconidia and the black sclerotia have been developed in culture.

Old cherries show pale grey or brown blisters or warts and the conidial fructifications of the fungus. What economic importance the fungus may have is as yet uncertain.

Bark Disease (*Fusarium lateritium*, Nees, var. *longum*, Wr.).—This disease appears to be no worse than in previous years. It has not been observed in other parts of the Territory, but has recently been recorded by Leach to occur in Nyasaland. The method of removing tops and branches gradually rather than to stump directly was suggested, in order to allow a continued flow of sap and the formation of new shoots before complete stumping back is undertaken. The results so far have been promising.

Toxic action of Grevillea flowers.—Leaves of coffee under Grevillea shade, in the Usambara mountains, showed small to large grey-brown areas, which can spread and destroy half or more of a leaf. The spots were so frequently associated with the presence of Grevillea flowers that there is no doubt the latter have a toxic action. The same action was previously recorded in the case of Sesbania flowers on coffee leaves and Tephrosia flowers on tea leaves. The leaf-spotting is not serious.

Effect of Leaf Mould at the Collar of Coffee.—On one or two plantations the deaths of a few coffee trees were shown to be associated with the accumulation of moist leaf mould and plant debris round the collars of the plants. On sloping ground the upper sides of the trees were affected. The trouble can be prevented by keeping the soil surface clear round the bases of the plants.

Sisal.

In January a memorandum was prepared briefly describing the diseases of sisal in this country. This was distributed by the secretary of the Tanganyika Sisal Growers' Association to members.

In co-operation with the Agricultural Officer (Sisal), Ngomeni, an experiment was planned on an estate in the Korogwe district to test the effect of applications of certain artificial manures on banding disease. The plots were laid out and are under the supervision of the above officer. It is hoped to have results in 1936.

Drought effects have been common in the crop during the long dry season of 1935. It is considered that the characteristic curling, spotting, etc., of the leaves are the result of the change from very wet to very dry conditions, rather than of the dry conditions themselves. In areas with a low rainfall the trouble is insignificant.

Cereals.

Sorghum.—Arrangements were made with Messrs. Smith, Mackenzie and Company, Dar es Salaam, for the importation of half a ton of flowers of sulphur for use in seed treatment of sorghum. Most of this has been taken for the Mwanza circle and the Kilosa district. A proprietary sulphur dust in an extremely fine form will be tested in the coming year.

Maize.—Recommendations were made for control of Head Smut, *Sorosporium reilianum* (Kühn), McAlp., on Mount Meru. There is still no evidence that this smut occurs below five thousand feet in this country.

Wheat.—Varieties of wheat, received by favour of the Senior Plant Breeder, Nairobi, were grown experimentally at Mufindi by the Agricultural Officer, Iheme. The objects were first to observe the incidence of forms of stem rust, *Puccinia graminis*, Pers., and so discover which wheat varieties could be grown without risk of infection and, secondly, to observe the general suitability of the varieties. The season was not, however, favourable for the appearance of the rust, and it will therefore be necessary to sow the diagnostic Kenya varieties again next year. The physiological form K3 of *P. graminis* is already known in that area. Other observations on this year's trials are being noted by the Agricultural Officer, Iheme. Stem rust was recorded from the Arusha district.

Wheat brown rust, *Puccinia triticina*, Erikss., and glume blotch, *Septoria nodorum*, Berk., are very common. A new record in the Territory is black chaff, *Bacterium translucens*, var. *undulosum*, Smith, Jones and Reddy, identified by Mr. J. McDonald. *Epicoccum purpurascens*, Ehrenb., was present at Mufindi in very small quantity.

Barley.—Dwarf rust, *Puccinia anomala*, Rostrup, is recorded from the Usambara mountains.

Rye.—Varieties resistant to brown rust, *P. secalina*, Grove, have been requested from the United States of America for trial.

Cotton.

Angular leaf spot was recorded at Nzega to be showing a higher incidence than is common in this country; the trial of certain proprietary preparations was recommended. Internal boll disease has been fairly common as usual.

Tobacco.

Material received at the laboratory from Iringa was very suggestive of hollow stalk, *Bacillus carotovorus*, L. R. Jones. The organism was not

isolated; dust from the inside of the diseased stalks produced a characteristic rot in tomato fruits, but this is not sufficient evidence of the cause of the disease. Tobacco leaf curl, a virus disease known in other districts, is now known in the Iringa district. Wildfire has again been recorded from Songea. The physiological trouble, blackfire, is recorded from Iringa.

Grape Vine.

As powdery mildew, *Uncinula necator* (Schw.), Burr., was stated to have been severe in the Usambara mountains in the previous year, estates were visited in February and advice given on methods of control. Downy mildew, *Plasmopara viticola*, Berl. and de Toni, previously observed at Ruvu, is now known in the Usambara and Moshi districts. As control of the two mildews is different, it is advisable that careful diagnosis be made.

Fruit Trees.

Crown gall, *Bacterium tumefaciens*, E. F. Sm. and Towns., has been destructive on an Usambara plantation in almond, plum, peach, pear and apple. When the disease is suspected advice should be sought from the laboratory. Rust, *Puccinia prunispinosæ*, Pers., previously observed on peach is now found on plum in the Usambara mountains.

Pine Mycorrhiza.

Mycorrhiza is present in older pine plantations. Examination of seedlings from Mufindi showed that it had been successfully established by the transfer of infected soil to seed-beds by the Forest Department.

Citrus.

Splitting of fruits was recorded from the Eastern Province. Orange scab, *Sporotrichum citri*, Butler, was identified on young orange trees at Muheza and on three-year-old trees in the Moshi district.

Cacao.

Ustulina zonata, Lév., has been observed associated with mortality in cacao, but the fungus is believed not to be an obligate parasite. On the same plantation, kapok and cassia sp. were also affected.

Legumes.

Lima bean, *Ph. lunatus*, L., is recorded as a new host of the leaf-spotting fungus *Ascochyta phaseolorum*, Sacc. The disease was observed in the Iringa Province. A mildew found on lentil at Morogoro is identified provisionally as *Arisiphe polygoni*, DC. Seed of a variety of groundnut believed to be resistant to rosette has been sent to Mwanza for trial.

Tomato.

Mosaic and also a fruit-rot, probably bacterial, are recorded in the Moshi district.

Chilli Pepper.

Wilting and dying of five to twenty per cent of plants on a large plantation were found to be caused by original poor planting; very small holes had been made for the seedlings, whereas the hard heavy nature of the soil demanded more careful preparation.

Mushroom Spawn.

In reply to a query regarding the risk attached to importing mushroom spawn, the Director of the Imperial Mycological Institute, Kew, states that he does not think there is any risk in importing mushroom spawn without a certificate, provided it is pure culture spawn and not the old "bricks."

Indigenous Grasses.

The following identifications have been made at the above Institute: *Ustilaginoidea ?ochracea* on *Setaria chevalieri*, Stapf. (*S. sulcata*); and *Ustilago evansii*, Henn., on *Setaria pallida-fusca*, Stapf. and Hubbard (allied to *S. glauca*).

* * * * *

As in former years I have to acknowledge the valuable assistance of the Director and staff of the Imperial Mycological Institute, Kew, and of the East African Agricultural Station, Amani.

Geo. B. Wallace,
Plant Pathologist

IX.—Seed and Plant Introductions to Stations, 1935.

Coffee Seeds.

C. arabica, Blue Mountain	from Jamaica.
C. stenophylla	,, Sierra Leone.
C. sp.	,, Moçambique
C. excelsa	,, Arusha.
C. congensis	,, E.A.A.R.Stn., Amani.
C. bukobense	,, ,, ,,
C. robusta varieties	,, Agric. Labs., Kampala.
C. arabica (Marajogipe and hybrids) ...	,, Marangu.
C. spp.	,, Abyssinia.
C. arabica	,, Maruka, Bukoba.
C. liberica	,, Uganda.
C. excelsa	,, ,,
C. sp.	,, Abyssinia, per Scott Labs., Nairobi.
C. robusta	,, Arusha.
C. arabica, F. 1 generation	,, E.A.A.R.Stn., Amani.
C. eugenoides	,, Kenya.

Coffee Plants.

C. robusta	from Uganda.
C. arabica, F. 1 generation	,, E.A.A.R.Stn., Amani.
C. travancorensis	,, ,, ,,
C. sp., Madagascar	,, ,, ,,
C. robusta varieties	,, ,, ,,
C. canephora	,, ,, ,,

Cover Crop Seeds.

Crotalaria alta	from E.A.A.R.Stn., Amani.
,, *avillaris*	,, ,, ,,
,, *anagroides*	,, ,, ,,
,, *cleanifolia*	,, ,, ,,
,, *erecta*	,, ,, ,,
,, *incana*	,, ,, ,,
,, *ivantulensis*	,, ,, ,,

Crotalaria juncea	from E.A.A.R.Stn., Amani.
,, *Kirkii*	,, ,, ,,
,, *laburnifolia*	,, ,, ,,
,, *lachnocarpoides*	,, ,, ,,
,, *marginata*	,, ,, ,,
,, *polysperma*	,, ,, ,,
,, *retusa*	,, ,, ,,
,, *spectabilis*	,, ,, ,,
,, spp.	,, ,, ,,
,, *striata*	,, ,, ,,
,, *usambariensis*	,, ,, ,,
,, *brachystachya*	,, Rio de Janeiro.
,, *vitellina*	,, ,, ,,
,, *retusa*	,, ,, ,,
,, *incana*	,, ,, ,,
Cassia australis	,, E.A.A.R.Stn., Amani.
,, *sophora*	,, ,, ,,
,, sp.	,, ,, ,,
Desmodium sp.	,, ,, ,,
Indigofera spp.	,, ,, ,,
Phaseolus lunatus	,, ,, ,,
Pisum arvense	,, ,, ,,
Sesamum radiatum	,, ,, ,,
Tephrosia volgelii	,, ,, ,,
Legume sp.	,, Senior Agricultural Officer, Moshi.

Shade Tree Seeds.

Aleurites fordii	from Morogoro.
Milletia oblata	,, Scott Labs., Nairobi.
Albizzia sassa	,, E.A.A.R.Stn., Amani.
,, *lebbek*	,, ,, ,,
Eucalyptus amygdalina	,, ,, ,,
,, *corynocalyx*	,, ,, ,,
Leucæna glauca	,, ,, ,,
Lucuma nervosa...	,, ,, ,,
Schizolobium excelsum	,, ,, ,,
Erythrina caffra	,, South Africa.
Spathodea nilotica	,, Dar es Salaam.
Acrocarpus fraxinifolius...	,, Kenya.
Brachychiton populneus	,, ,,
Calpurnea aurea	,, ,,
Entrolobium timbouva	,, ,,
Erythrina tomentosa	,, ,,
Phytolacca dioica	,, ,,
Sesbania punctata	,, ,,
Crotalaria agatiflora	,, ,,
Inga edulis	,, E.A.A.R.Stn., Amani.
Cedrella Toona	,, ,, ,,
Sesbania grandiflora	,, ,, ,,
,, *punctata*	,, ,, ,,
,, sp.	,, ,, ,,
Mæsopsis Eminii	,, ,, ,,
Albizzia stipulata	,, ,, ,,
Erythrina velutina	,, ,, ,,
Dalbergia microphylla	,, ,, ,,
Croton melagocarpus	,, ,, ,,

Mimosa brachytinga ... ... from Senior Agricultural Officer, Moshi.
Albizzia lopantha ... ... ,, Kenya.
Ricinus sp. (Giant Castor) ... ... ,, ,,

Miscellaneous.

Paspalum dilitatum ... ... from Australia.
Wimmera Rye Grass ... ... ,, ,,
Beersem Clover ... ... ,, ,,
Lotus corniculatus ... ... ,, ,,
Medicago lupulina ... ... ,, ,,
Phalaris tuberosa ... ... ,, ,,
Saccaline sorghum ... ... ,, ,,
Sheep's Burnet ... ... ,, ,,
Cymbopogon citratus ... ... ,, E.A.A.R.Stn., Amani.
Cinchona succirubra ... ... ,, ,, ,,
,, *Ledgeriana* ... ... ,, ,, ,,
Gardenia globosa ... ... ,, Kenya.
,, *urcelliformis* ... ... ,, ,,

Annexure V

THE SISAL EXPERIMENTAL STATION, NGOMENI, TANGA.

Report for the Year ended 31st December, 1935.

Foreword.

The Sisal Experimental Station was instituted in late 1934 when Mlingano Estate was purchased by Government. In consequence this is the first annual report to be submitted and it reviews the progress made since the inception of the station. Clearing operations began on the 19th November, 1934, but most of the developments made so far were carried out during the year 1935.

The Development of the Sisal Experimental Station.

1. *Introduction.*—(a) The preparation of Mlingano Estate for an experimental station formed the chief feature of the past year's activities, and may be regarded as an important part of the work of equipping the station. The condition of the property at the time it was acquired, combined with the habit of the sisal plant, made it necessary to wait twelve months before field experiments could be commenced. Whilst land was cleared of dense forest, bulbils were growing in the nursery in order that as little time as possible be lost in planting up experiments when the experimental area became ready.

(b) The estate is a large one, more than adequate for immediate requirements. Three-quarters have now been opened up and, at the present time, enough land has been made ready to enable field experimental work to be proceeded with as soon as planting material and season permit. In this connection it may be mentioned that sisal field experiments demand rather more space than those dealing with many other crops. Land for demonstration plots has been provided as well. The station as a whole is in a fairly advanced stage, and only needs attention to finer details, aided by time, to give it a finished and mature appearance.

2. *Staff: European.*—(a) Mr. G. W. Lock, Agricultural Officer, returned from leave on the 22nd October, 1934, to assume duties of officer in charge of sisal experimental work. Pending the acquisition of land he resided in Tanga, and transferred to Mlingano Estate on the 14th March, 1935.

(b) Mr. H. A. B. Fowler, Agricultural Assistant, arrived from transfer from the Lindi Province on the 13th December, 1934, when he occupied temporary quarters on Mlingano Estate. Throughout the year he has supervised labour and assisted in the general administration of the station.

3. *Staff: African.*—The present African staff of the station comprises two clerks and three recorders. One African instructor was seconded from the entomological laboratory, Morogoro, for sisal weevil studies. Other natives employed regularly include a carpenter, two watchmen and several headmen.

4. *Labour.*—Only a small labour force could be mustered for the first six months of the year but after the long rains the supply improved. The progress of clearing work to a large extent has depended upon the labour

forthcoming. The number of resident labourers has been restricted by a water shortage and the majority of workers live in the neighbourhood. The average daily attendance throughout the year was 169 labourers. Standard wages of twelve shillings per working month of thirty days were paid for all classes of work.

5. *Weather.*—The station has been equipped by the British East African Meteorological Service as a second order meteorological station. Rainfall records commenced on the 9th February, 1935. Prior to this date the rainfall was negligible thus the total rainfall measured may be taken as for the complete year. Mlingano Estate lies in a belt of country where slightly drier conditions prevail than nearer the coast of further inland. The total rainfall for 1935 was 1,252·5mm. on 109 days; a wet year with a fairly even distribution of rain. Such weather was not propitious for clearing work, particularly in the case of Ceara rubber, and intensified rubber seedling growth which required frequent weeding to eradicate it.

6. *Progress of Development.* (a) *Description of Mlingano Estate.*—A brief description of Mlingano Estate is a necessary adjunct to outlining the developments made on the property since it became the Sisal Experimental Station. The estate consists of a rectangular block of land, 440 hectares (1,087 acres) in size, based on an old railway alignment in the south and extending northwards for about one and a half miles. It is divided roughly in half lengthwise by the Kibaranga road—a turning off the main Tanga-Muheza road which nearly coincides with the southern boundary. Except for a narrow strip of forest on the eastern side, practically the entire estate was covered with an impenetrable growth of well developed Ceara rubber and an undergrowth equivalent to a stand of fairly thick bush. There were no buildings apart from a derelict house.

(b) *Preliminary Operations.*—The key to the development of the estate lay in finding large areas of level uniform land, suitable for field trials. Therefore, the first step taken was to examine the topography carefully, and from this survey it was apparent that the land was more level in the southern than in the northern half. Eventually all the bush was cut in the southern section and rubber felling started in December, 1934. By March, land had been provided for planting *Agave amaniensis*, and agave collection and building plots, and also all standing rubber on land reserved for experiments had been felled. The buildings face north-west and are grouped at the head of a valley in the centre of the southern portion of the estate, whilst the experimental areas lie on all sides except in front of the houses.

(c) *Clearing Work.*—The clearing work was heavy as it consisted of the removal of undergrowth, primary and secondary rubber and large trees and stumps. In the southern half all the rubber was felled below ground level, whereas elsewhere it was rough axed and left to rot. Burning was barred on experimental areas owing to the disturbing effect upon soil uniformity; the rubber debris was carried off by light railway and burnt on the outskirts. The southern experimental area (13 hectares) was dug over, disc-harrowed, and is now ready for planting. It will accommodate twelve experiments after allowing for roads. The western experimental area is larger and so far eight hectares have been prepared. Prolonged showery weather added to the difficulties of coping with ordinary weed growth and especially with seedling rubber.

7. *Summary of Clearing Work.*

Operation	Hectares	Acres
Cutting undergrowth	207·07	511·46
Stumping undergrowth	63·55	156·96
Digging round rubber	131·34	324·40
Felling rubber	156·51	386·58
Rough felling rubber	157·76	389·66
Stacking and burning (repeated 3 times)	30·13	74·42
Cutting up felled rubber	34·95	86·33
Clearing experimental areas	21·58	53·30
Total area completely cleared	51·71	127·72
Total area opened up	314·27	776·24

8. *Planting.*—Early in the year one level hectare of land was carefully prepared for a nursery and planted with graded sisalana bulbils, spaced 50cm. by 25cm., which have grown satisfactorily. For good uniform material it was found best to take bulbils from strong parent plants. A plantation of seven hectares of *Agave amaniensis* planted in March has made rapid strides and is very healthy. Stolons were produced after eight months and ten thousand young suckers were counted recently. Other plantings include a collection of nineteen different species of agaves, a nursery of *Furcræa gigantea*, trial plots of various cover crops, ramie, and *Mundulea suberosa*. All have made good progress except the ramie which is patchy. A sheltered valley in front of the buildings has been cleared for planting citrus.

9. *Water Supply.*—The station is handicapped by the lack of a good water supply. An old breached dam at the northern end of the estate was repaired and strengthened for impounding surface water; so far results are disappointing. Underground seepage water is copious but unfortunately is brackish. A borehole, 145 feet deep, drilled recently by the Geological Department, tapped water in plenty, but this is also very brackish.

10. *Roads and Buildings.*—Approach and service roads have been made in the southern half of the estate, and grounds laid out as far as building operations could allow. The construction of the houses and office was completed by the Public Works Department in December; before this temporary quarters were occupied by the staff.

11. *Experimental Work.* (a) *Field Trials.*—For reasons already given, little experimental work could be conducted on the station during the past year, and had to be confined to outside estates. One manurial trial was laid down in connection with banding diseases, and another in young, rather unthrifty sisal, on land which has supported sisal continuously for thirty-two years. The latter trial should give an early indication of the manurial requirements of sisal on coastal formations. Although leaf counts and measurements are made periodically, it is still too soon to detect any significant responses to treatments. A spacing experiment was put down recently in an area of low rainfall, where competition between plants for soil moisture is accentuated by the dry conditions. Important differences cannot be observed as yet in two trials started in the nursery in relation to spacing and manuring. Attempts to poison cassia trees were not successful and are to be continued.

(b) *The Sisal Weevil.*—With the co-operation of the Assistant Entomologist, the sisal weevil *(Scyphophorus acupunctatus)* has been under close investigation, and its habits and life history determined in breeding cages. Plant sanitation is one means of controlling this insect, but alternative

methods were sought through poisoning and trapping. Some poisons proved effective; the principal limitation to their use on a field is that the expense would be out of proportion to the damage caused by the weevil. Despite testing a wide range of substances, a powerful attractant was not found.

12. *Board of Management.*—Members of the Board of Management appointed during the year, and the Director of Agriculture, inspected the station on various occasions.

13. *Publications.*—A pamphlet on sisal experimental work was prepared early in the year, for which outside inquiries have been received. Two articles were submitted to the East African Agricultural Journal.

14. *East African Agricultural Research Station.*—The closest touch has been maintained with the East African Agricultural Research Station, Amani. The Director and other members of the staff have visited the station frequently, and their assistance in many ways is gratefully acknowledged.

G. W. Lock,
Agricultural Officer (Sisal)

MOROGORO EXPERIMENTAL STATION.

Annual Report, 1935.

1. *Climatic Conditions.*—An abnormally low rainfall was recorded in April; this, however, did not adversely affect the crops on the station except the cotton strains which failed to germinate in March and so had to be replanted in a dry April. The high rainfall during the months of June, August and September adversely affected the cotton crop of the district.

2. *Experimental Section.* (a) *Cotton Selection Work.*—Nothing of value was obtained from the progeny rows of 1934 S.P.S. owing to the rank growth of the plants, their diseased condition and to the poor stand. All will be replanted in progeny plots in 1936, together with the 673 selections of 1935, on Kingolwira Extension Farm. Both of the strain trials were failures owing to the seed not being viable. Seed of the 1934 strains only is available for further experiment. Excepting No. M.J.R. 322, seed of the long-linted strains mentioned in the last Annual Report has been lost; the seed harvested in 1934 was not viable.

(b) *Introduced Strain trials.*—

I.—Barberton Strains.

	Strains in order of yield	Seed-cotton lbs. per acre	Difference required for significance	Ginning %
1	998	1,204		36·5
2	955 or U/4	949	46lb. per acre	36·3
3	920	930		34·7
4	U/4 or 955	699		36·3
5	U/4	653		34·4
6	Local	434		31·7

Each shows a significant difference from the others excepting 920 over U/4 or 955.

II.—Nyasaland Strains.

	Strains in order of yield	Seed-cotton lbs. per acre	Difference required for significance	Ginning %
1	U/4/4/2	1,052	188lb.	35·5
2	N.3	785		35·0
3	U/4/2	757		34·3
4	U/4/4/2/955	720		35·1
5	No. 10	688		35·4
6	Z. 14	622		36·1
7	C. 28	602		36·6
8	Local	555		32·0

U/4/4/2 is a significantly higher yielder than all. Local is a lower yielder than U/4/4/2, No. 3 and U/4/2. N.3 is a higher yielder than C.28 or Local. U/4/4/2 on these figures will produce 368 pounds of lint per acre compared with 172 pounds of Local.

These results are very gratifying but not too much reliance should be placed on their degree of superiority in yield over local until what may be new-place effect has had time to wear off. Lint samples have been forwarded to England, together with bales of the Barberton strains grown at Kingolwira. A reliable report should be obtainable from these two sources to give us

grounds to discard some and multiply others. High ginning percentage should make up for any loss in premium and we may still be left with a higher yielding character to benefit the growers.

(c) *Sorghum variety trial, first year.*—

Variety	Yield per acre lbs.	Mean number tillers per plant	For yield. Difference required for significance
Kobero ...	2,705 ...	2·32	484lb. per acre.
Katembo ...	2,575 ...	1·99	
Bangala ...	2,571 ...	2·09	
Shware ...	2,469 ...	2·26	
Jebere ...	2,416 ...	2·53	
Mdula ...	2,267 ...	2·18	
Karachi ...	2,065 ...	3·77	
Kibamba ...	1,613 ...	1·69	

Kibamba is thus a significantly lower yielder than any other in the trial. Karachi is also lower than either Kobero, Katembo or Bangala, but owing to the poor stand obtained in the plots of that variety and the high weight of grain per head the lower yield is not considered to be significant. Mdula matured late, whilst both Bangala and Karachi lodged badly.

(d) *Summary.*—In view of the fact that such poor stands have been obtained in the trial owing to wash within the ranges already partially defended by parallel ridges, it was decided to contour-ridge the whole farm at two-foot vertical intervals. This has resulted in thirteen contour ridges running approximately south-east to north-west whereas the parallel ridges ran directly east to west. There is, therefore, a fall of twenty-six feet from one end of the experimental area to the other, amounting to one in sixty-seven. On some soils this fall would be pronounced as inconsiderable, but this soil is very prone to surface wash. Fourteen new experiments and the four old ones have now been laid out along these contour ranges, with considerable wastage of land, it is admitted, but it is hoped that results will now be more satisfactory and errors reduced. A new system of recording has been introduced on Ukiriguru lines, and costing, layouts and records will now be more or less standardized with those of Lubaga and Ukiriguru. Sites for experimental work have been selected at Kingolwira, though these are not ideal, they should, when contoured, prove fairly suitable and there is no doubt that the soil is more typical of the soils of the plains of the Eastern Province. It will relieve the congestion at Morogoro when the cotton experiments can be transferred thither in 1937.

3. *Dairy Herd.*—In March of this year the continued fall in the average milk yields per cow was causing us some concern, and in addition to which late in 1934 there were numerous new cases of trypanosomiasis. It was decided to give stall-feeding a trial, particularly as the pasture available was being badly overgrazed. Early in April this was begun and the figures appended will show that the results favour the change. High average milk yields per cow were recorded till August, 1934, when the first native cows came into milk. This, of course, adversely affected the mean milk yields. However, the yields still went on decreasing and not always proportionately to the number of native cows in milk. For the seven months previous to stall-feeding the average yield per cow was 6·6 pounds, whilst for the seven months following, the average rose to eight pounds per day. The total milk yield for the year is well below that of 1934 but the figures appended explain this.

I.—Total Milk Yield for the Herd.

Year	Lbs.	Mean yield per cow per day
1933	47,824	—
1934	45,471	9·5
1935	32,083	6·9

II.—Average number of Female Stock in milk per month.

Year	Grade	Native	Total
1934	12	1	13
1935	8	3	11

The drop in the figures of trypanosomiasis cases is also gratifying. The only cases of first attacks occurring with oxen which move about over the farm.

III.—Female Stock Cases of Trypanosomiasis

Deaths, various	Tryps 1st attack	Tryps Relapses	Average size of herd during year
1933 8 (2 Tryps)	24	12	20
1934 2 (2 Tryps)	4	17	21
1935 2 (1 Tryps)	0	9	19

The drop in milk yield of cows which were not dried off makes an interesting comparison and indicates the value of giving cows a resting period before calving, which it is difficult to do under large-scale ranching conditions.

IV.—No Dry Period.

Cow	Lactation lbs. milk per day 1st	2nd	3rd
Josephine	12·5	12·2	9·3
Balnagask	10·3	7·3	
Kilbrine	11·2	7·4	
Mkali	11·9	7·0	

V.—Even Lactation with Dry Period.

Cow	Lactation lbs. milk per day 1st	2nd	3rd
Lulu	8·3	8·0	10·5
Susie	9·3	14·8	14·0
Margaret	13·3	15·1	

The introduction of a dairy herd on to the agricultural station, and the manufacture of compost and farmyard manure in conjunction, has made it possible for us to demonstrate the possibilities of the small dairy industry in Dar es Salaam developing on stall-feeding and soiling instead of ranching lines. It is evident that in time it will become increasingly difficult for the cattle owners to produce milk at a profit under the latter method, apart from the fact that it is ruining the potentialities of the area. Large quantities of bye-products and waste are dumped or burnt by township authorities and factories, whereas they could all be turned into milk by the composting process. On this station twenty-eight head of cattle and fifteen calves and yearlings have been maintained on fifteen acres of land—half of it of the rather poor and in this case, overworked red soil type—of which four acres have been irrigated during the dry season. Accurate records have been kept and these show that this has not been undertaken at a loss and it precludes the necessity of having large acreages of land, which, particularly in the

Eastern Province, expose the cattle to tsetse fly. In addition, the manufacture of compost, or even of farmyard manure which involves little extra labour but produces a smaller bulk, affords manure for the production of vegetables, and yard-crops, in addition to the fodder crops returned directly to the cattle. Further, when only mediocre pasture is available for grazing, stall-feeding gives an increased milk yield and maintains the animals in perfect condition.

VI.—Native Cows.—Daily milk yield.

Cow	Lactation, 1934	Lactation, 1935	Comparison between
Mwajuma ...	8·4 ...	12·4 ...	first 3 months of lactation
Kayanda ...	4·0 ...	8·3 ...	first month of lactation
Bado	— ...	5·2 ...	first lactation

From this herd the nucleus of the milking stock for the Kingolwira settlement holdings will be derived and for this reason all calves are being brought to maturity on the farm. For six months the grade cows were served by the native bull and native cows by the grade, but the native bull no longer serves any of them.

4. *Compost Making.*—Farm residues and cotton seed have been the chief materials used for compost manufacture, the former includes khus khus grass principally, also maize and sorghum stover and residues from the thrashing floor, etc. For the last nine months of the year since the process was started, 157 heaps have been made. This is equivalent to about 200 tons of compost per annum. Of these heaps forty have been made from bedding alone on the lines of the Indore method. About 100 tons of cotton seed have been consumed. The following are brief and approximate figures of production :—

Heaps. 14′ × 8′ × 2′ deep. require 1 ton of cotton seed plus *bedding.* After three months 1½ tons of compost are produced at a cost of Shs. 2/- per ton.

Cattle. Six head will produce 80 tons of compost per annum destroying 50 tons of cotton seed.

Trials have been made with other materials or by different methods.

(1) Cotton seed by itself in layers with the usual dressing of slurry, and watering, proved unsatisfactory.

(2) Sisal suckers and stumps laid in heaps in the sun for 6 months and then incorporated into a heap with layers of cotton seed, broke down very well.

(3) Bedding by itself according to the Indore method has proved as satisfactory as the bedding-cotton seed method, but the process takes a little longer.

(4) Trials with sisal waste are now being undertaken and the heat attained within the heap foretells success.

(5) One beast should produce four tons of farmyard manure per annum whilst in the same time it can produce thirteen tons of compost.

No offensive smell has been noted on the factory site nor does the temperature of the heap allow the breeding of flies or other insects. A Medical Officer inspected the heaps and considered the heat obtained as very satisfactory.

No results have yet been obtained of the effects of this compost as a fertilizer but trials are being undertaken in 1936.

5. *Fodder Crops.*—Edible canna, Rhodes grass and elephant grass have all proved of the utmost value as feed for stock. Sweet potatoes form an excellent cover crop, interplanted between elephant grass or edible canna. Planted alone they yielded ten and a half tons of vines, and eight and a half tons of roots for cattle fodder. Bulrush millet three months from sowing yielded fifteen tons of green fodder and five and a half tons hay per acre. It is more drought resistant than maize and planted close gives heavy yields per acre. Khus khus grass fed green or after being sun-dried for a day is a palatable food, at any rate for oxen. Maize stover is relished by all the stock.

6. *Plant Multiplication and Propagation.*—The usual service has been rendered in the form of sale of citrus, ornamental plants, seed and other planting material. *Agave amaniensis*, onions, rice, maize, lentils, legumes, sorghums, derris and ramie have been under multiplication. Regarding the latter Mr. Wight has a note to add.

(a) *Ramie.*—Two varieties of ramie, *Boehmeria nivea* and *B. utilis*, are being grown at the station. Up to the present the former has made very poor growth, whilst the latter seems well suited to local conditions and has produced stems of about six feet in height. With the rainfall at this station (approximately thirty inches a year) two cuttings might be expected per year, with irrigation, however, it should be possible to obtain three to four cuttings.

Work has been carried out on the preparation of the fibre and samples of prepared fibre have been sent to England for examination.

(b) *Derris elliptica.*—Plants are growing well but as yet are not old enough to carry out tests as to the rotenone content of roots from this locality.

(c) *Soya Beans.*—This crop, really a sub-tropical one, has been tried out during the past year, both as a rain grown crop and under irrigation during the dry season. The trials strongly indicate that this crop is not at all suited to conditions here. The plants never grew to more than six inches in height and while a small amount of seed was obtained, the yield was far too small to be of any economic value. Dressing the seed with the appropriate bacterial inoculant produced no obvious beneficial effect.

N. V. Rounce,
Agricultural Officer

Annexure VII

THE EXPERIMENTAL STATION, MPANGANYA, RUFIJI.

Annual Report for the year ended December, 1935.

Introduction.—After an inactive period of four years Mpanganya was reopened as an Experimental Station in November, 1934. Initial operations were, therefore, devoted to felling and clearing and making general provision for planting in February, 1935.

2. The station serves a population of eighty thousand people mainly concentrated at, or near, the Rufiji river, which roughly bisects the district. Cotton has been grown in this area since German times but with mixed success. The production of rice is of paramount importance, being the staple crop of the native cultivator; thus it is desirable that investigation of both crops should proceed side by side.

3. Bearing in mind the foregoing, the programme of work was drawn up with the following motives :—

(a) To evolve a type of cotton, if possible from the existing variety in general cultivation, more suited to the peculiar environmental conditions of the Rufiji district and capable of showing a more regular and longer staple length.

(b) To examine the behaviour of the existing varieties of rice with a view to the elimination of the majority and the improvement of a selected few for distribution throughout the district.

Although these are the prior aims of the station, the extension and improvement of other economic crops and the investigation of agricultural practices will receive attention as the station becomes established.

4. *Cotton.*—Planting was commenced at the end of February and continued until the middle of March as follows :—

(a) A bulk crop of Egyptian cotton.

(b) A half drill strip experiment with U/4/4/2 and local cotton.

(c) An observation plot of U/4/4/2.

(d) Selection received from Morogoro : Mp. 9, Mp. 17, Mp. 19, Mp. 42, Mp. 92. MJR. 245, MJR. 249, MJR. 250, MJR. 253, MJR. 251, MJR. 244.

(e) A bulk crop of local cotton.

The seed of the MJR. selections was of poor quality, stands were extremely patchy; other strains were good. All cotton was planted at a spacing of three feet by eighteen inches and thinned to two plants per hole at the beginning but later in view of the good condition of the crop it was again thinned to one plant per hole. Without exception all strains progressed remarkably well during the month of March. Aphid attacks were general but disappeared in the hot dry month of April and did no damage. With the heavy rains of May the plants grew into trees of six to eight feet tall and the plots presented an almost impenetrable appearance rendering selection work extremely difficult.

5. The bulk crop provided material for selection and fifty-six plants of good shape and short stature were selected and self pollinated. These will be planted in progeny plots next season. The need for a less vegetative type of plant for the Rufiji district is pressing.

6. *Egyptian.*—It was evident from the seed that the so-called Egyptian was far from pure. An average height of seven feet was attained and the crop was a failure.

7. *U/4/4/2.*—U/4/4/2 was outstanding in its wealth of bolls and comparative shortness of stature. A yield of 1,171 pounds per acre was obtained with mean lint length one and one-sixteenth, fairly regular. The lint appears much stronger than that previously examined in drier parts of the Territory. Selfed seed is available for next season.

8. A half drill strip experiment was laid down with ten replicates of U/4/4/2 and ten replicates of the local cotton. A significant difference in favour of U/4/4/2 was obtained, as follows:—

Standard Error	=	19·09
Probable Error	=	12·87
Probable Error of the Mean of ten differences ...	=	4·07
	=	20·4 + 4·07
Mean yield of U/4/4/2 per acre	=	624lb.
Mean yield of Local per acre	=	552lb.

The much lower yield of U/4/4/2 in this experiment compared with that of the U/4/4/2 bulk crop will be noted, as the end rows north and south, however, yielded respectively 861 and 991 pounds it can be inferred that the shading effect of the local cotton contributed largely to the reduction in yield.

9. *Cotton Selections.*—The MJR. selections received from Morogoro proved disappointing in germination, stands obtained ranged only from five to eleven per cent of the possible totals. Most of the plants made excessive vegetative growth and fell over or trailed on the ground. The lint is strong, particularly that of MJR. 243, 244 and 245, but shows no advance in length over that of the local cotton. The yields per plant were obviously very good but on account of the poor stands no comparisons were made. The Mp. selections were originally made at Mpanganya a number of years ago and have been kept going, but it is suspected that crossing has occurred in the meantime. Unwieldy growth resulted; the lint length is not now outstanding but yields of 760 and 570 pounds per acre were obtained from Mp. 12 and Mp. 17 respectively. Selfed seed of all the strains has been obtained but the success of cotton growing in the Rufiji district would appear to lie in the evolution of a much shorter statured type than any of the strains tried this year, with the possible exception of U/4/4/2 which, however, for the present at any rate, is ruled out on account of its shortness of staple and its predisposition to diminish in yield after acclimatization. Crosses between U/4/4/2 female and typical Egyptian male were made and the seed from five bolls is available for planting subsequent back crossing next year.

10. *Insect Pests.*—The most troublesome pest of the season was pink boll worm (*Platyedra gossypiella*) and this, combined with the high incidence of cotton stainers (*Dysdercus* sp.) resulted in diminished yields with no clean pickings. Rain-grown cotton throughout the district was generally infested with pink boll worm. A severe infestation of Mylabrid beetles on a cover crop of Dolichos lablab, was completely eradicated by hand picking in the early mornings before the beetles had reached the active stage. In connection with insect pests reference must be made to a method of cotton culture, locally termed Mlao, and of which some investigation has been made this year. An Mlao crop is one which is planted on the rich alluvial deposits, at or near the river after the floods have subsided and exposed the areas for

cultivation. By reason of the high-water table in such areas, crops of cotton and maize, etc., can be grown and matured practically independent of rainfall.

Thus in the Rufiji district there are two systems of cotton cultivation, namely :—

(a) Rainfall cotton which is planted on areas not subject to flooding, in the months of February (latter end), March, April and even May.

(b) Mlao cotton which is planted in May, June and July as the inundated areas become exposed for cultivation.

Mlao areas are of course determined by the volume of the floods. An abnormally high flood this year has resulted in a large acreage of Mlao and more than two-thirds of the total cotton crop of the district has been produced from Mlao lands. Furthermore, Mlao cotton has been remarkably free from insect pests. In view of the similarity of conditions with those of the Tokar delta in the Sudan, seed has been obtained from Tokar for trial on typical Mlao areas next season.

11. *Rice.*—The planting of rice commenced on the 19th February and consequently early growth was considerably retarded by the drought period of April. From the whole series of experiments it was practically impossible to gauge the normal behaviour of the strains and varieties under trial as all were stunted and considerably below normal height, nevertheless the drought-resisting properties of each is represented in the ultimate yields.

12. *Observation Plots.*—Observation plots of twenty-one varieties of rice were planted. Mass selections of all the varieties were made; these will constitute the basis of a purer seed supply of those varieties which are considered desirable to multiply.

13. A randomized block was laid down with twenty-one treatments and twenty replicates, the results are as follows :—

S.D. of any plot (error variance) ... ... = 6·63
S.E. of any mean ... ... = 1·048
S.E. of the difference between any two means ... ... = 6·948
Difference = 1·959 ∴ difference = 1·959 × 6·949 ... = 13·61
S.E.

Therefore a difference between any pair of treatment means, greater than 13·6, is significant.

Treatment Means in order of Value.

Likote	... ...	21·1	Maridadi	... ...	11·0
Borakupata	...	21·0	Alibasi 10	... ...	10·8
Ngohe	... ...	19·7	Akirimali	... ...	10·8
Ngwimsimba	...	19·2	Faya	... ...	10·4
Komango	... ...	18·8	Ulaiti	... ...	8·2
Bungala	... ...	18·3	Kajua	... ...	6·3
Kilimali	... ...	17·6	Rusukwe	... ...	6·2
Mwanga	... ...	16·7	Afaa Mpemba	...	5·6
Afiri	... ...	16·2	Afaa Mkoma	...	4·9
Karafuh	... ...	13·5	Marula	... ...	4·5
Samanini	... ...	11·7			

Significant differences between some of the varieties will be noted, e.g. :—

(a) Likote and Borakupata are significantly superior in yield to Kajua, Rusukwe, Afaa Mpemba, Afaa Mkoma and Marula.

(b) Likote, Borakupata, Ngohe and Ngwimsimba are superior in yield to Afaa Mpemba, Afaa Mkoma and Marula.

(c) Komango is significantly greater than Afaa Mkoma and Marula.

(d) Bungala is significantly greater than Marula.

14. *General.*—During the year under review, quarters, both European and Native, have been repaired and renovated. Two additional houses for the native staff have been built. A dispensary, quarters and staff have been provided by the Medical Department, a service which is greatly appreciated by the local natives. A well has been dug which supplies sufficient good water for domestic use and irrigation of the new gardens which are now in the course of preparation. An aerodrome has been constructed; "game" fences have been erected and roads and firebreaks have received attention. Preparation for next season's activities are well up to the time table planned and signs are not lacking that more normal growing conditions will prevail in 1936.

H. MARSLAND,
Agricultural Officer

ANNUAL REPORT OF THE LUBAGA EXPERIMENTAL STATION.

Section I.—Capital Improvements.

1.—introduction.

As it was decided that the Lubaga Farm should serve the hinterland area of the Lake Province, as an agricultural centre, it was found necessary to reorganize the entire farm, and to carry out some capital improvements.

2.—building work.

(a) The Agricultural Assistant's house was rebuilt and extended. In addition a six thousand gallon underground rainwater tank was built.

(b) An underground concrete rainwater tank was constructed having a capacity of approximately twenty-four thousand gallons. Reinforced concrete was used throughout. This tank is for the storage of rainwater caught from the surrounding roofs of the stores, offices, etc., and was used by the labour for drinking purposes during the dry season.

(c) A large open rainwater catchment tank was built adjoining the experimental area. This tank is linked up with the new anti-erosion banks, all the surface water off the experimental area will be directed into the tank. The capacity of the tank is approximately two hundred and fifty thousand gallons. This supply will be used by the cattle during the dry season, the water will be pumped out into troughs. The entire excavation work, with the exception of trimming up the walls, was done with ploughs and damscoops, and the total cost was under two hundred and fifty shillings.

(d) Tool stores, implement sheds and seed stores were built or modified to meet the present requirements. A black-smith and carpenter's shop was also erected.

(e) *Covered Cattle Yard and Cow Byre.*—Provision was made for the manufacture of good farmyard manure. A covered cattle yard eighty by fifty feet, was built of bush timbers, with a thatched roof. Low walls of mud brick were built around the building to consolidate the manure and to prevent it drying out unnecessarily. A cattle byre was also built, using native materials. It is intended to be a demonstration byre which can be constructed readily by any cattle owning native.

(f) *Dairy.*—A dairy in the form of a twenty-foot rondavel was constructed, to demonstrate the hygienic methods of handling milk.

(g) A seventy-foot thatched barn was built for the drying out of the *Feterita* sorghums during the rains.

(h) *General.*—In the workshops two old motor car chassis were converted into pneumatic tyred ox wagons for use on the farm. These have been in constant use throughout the year, and have given satisfactory results.

Section II.—Agricultural Policy and Anti-Soil Erosion Work.

In the beginning of the season it was decided that the farm should serve as an experimental station, a Native Authority seed farm, and as an educational centre. It was apparent that the policy of the farm must be based on soil fertility conservation, and must provide adequate food for the stock during the months of the dry season. Further, it was decided that

drastic steps should be taken immediately to stop the soil erosion. A three-year plan was started which included :—

(a) The building of contour and horizontal anti-erosion banks.

(b) A new system of farm drainage.

(c) The planting of windbreaks.

(a) *Contour Bank and Horizontal Anti-erosion Banks.*—The contour banks were placed at intervals of seventy yards and were built up by hand. In the latter part of the year the remaining portions of the farm were laid out on the Havilland system and contour ridges were made with the use of a Martin's ditcher and tractor. These contour banks were put in every one and half foot vertical fall, while the banks have a discharge fall of one in four hundred. The horizontal banks dividing up the land into blocks one acre in width were used on lands having an even and regular fall, which would be used eventually for experimental purposes. This system was adopted for convenience in order to facilitate the lay-out of regular shaped blocks.

During the year over one hundred and ten thousand yards of contour and horizontal banking were built up to an average height of two feet.

(b) *A New System of Drainage.*—A new system of drainage was introduced, (a) to carry off the surface water from the farm and (b) to prevent surface water from entering the farm from the adjoining native gardens. Approximately six thousand yards of drain cutting was done.

(c) *The Planting of Windbreaks.*—Windbreaks in the shape of a large letter H were laid out and will be planted during the coming rains. Each windbreak consists of six rows of *Cassia siamea* with a row of *Euphorbia* (*Manyara*) on each side. These outside rows will protect the young trees and will give additional density to the breaks.

Section III.—Experimental Work.

1.—general.

It was decided to work in the experimental programme with the general agricultural policy of the farm, in order that the soil fertility could be restored and maintained. Further, it was decided to reduce the experimental work to a minimum until the reorganization had been completed.

A five-course rotation was introduced to meet the requirements of the farm. It is designed to restore soil fertility, to allow for the multiplication of seeds, and to provide adequate food and roughage for the stock. It consists of :—

1st Year.—Feterita sorghum. Followed by bulrush millet, Virginia Bunch groundnuts, for hay, or *Dolichos lablab* cut green or sunn hemp.

2nd Year.—Farmyard manure then awned bulrush millets.

3rd Year.—Cotton experiments of fodder.

4th Year.—Pigeon pea, then interplanted maize for ensilage.

5th Year.—Pigeon pea.

In addition to the above, covered cattle yards were erected in order to provide adequate supplies of well-rotted farmyard manure. The lack of water prevents the manufacture of compost manure made under the Indore system.

2.—cotton.

As Lubaga serves the U/4/4/2 cotton zone of the Shinyanga, Northern Nzega and Kahama districts, it is necessary to have information regarding the relative merits of this cotton.

The cotton work was divided into two divisions :—

(i) Comparative work.

(ii) Observation and selection work.

(i)—*Comparative Work.*

(a) Using U/4/4/2 as the control comparisons were made with :—

(i) The latest U/4 derivatives from Barberton.

(ii) The latest Uganda Upland selections from Ukiriguru Experimental Station, Mwanza.

(b) In addition two variety trials between the commercial Mwanza lake-shore cotton seed (Uganda Upland) and the Local U/4/4/2 were made.

A. MAIN COTTON VARIETY TRIAL.

A trial consisting of thirteen varieties and strains were planted in a randomized block, with six replications.

Varieties :

(i) Barberton : 921, 920, 955, 998, U/4/4, U/4 Bulk, 9264 R, 9355 R.

(ii) Control : U/4/4/2.

(iii) Mwanza Bulk.

(iv) Ukiriguru selections, Mwanza 561, 572, 570.

Results :

Table of analysis of variance :—

(i) *Value of Z* = ·6109.

Value at P·05 = ·3255

,, ,, P·01 = ·4574

Treatments effect is significant at P·05 and P·01.

(ii) *T. Test.*

The standard error of 2 Means = 17·2046.

Difference required for significance—

at P·05 = 33·720

at P·01 = 44·316

Using U/4/4/2 as the basis for comparison, which yielded 450 pounds of seed-cotton per acre, the following gave significantly greater yields :—998, 921, 920, U/4/4, 955. The varieties are in order of merit. All the Uganda Upland varieties were below the U/4/4/2 figure.

The following table gives the results in yield per acre and differences from the Control (U/4/4/2) :—

Variety	Yield per acre	Difference from U/4/4/2
998	560	Plus 110
921	558	,, 108
920	520	,, 70
U/4/4	516	,, 66
955	503	,, 53
U/4 Bulk	473	,, 23
9355 R	464	,, 14
U/4/4/2	450	,, 0
Mz 561	446	Minus 4
Mz 570	440	,, 10
Mz Bulk	425	,, 25
9264 R	400	,, 50
Mz 572	386	,, 64

B. UGANDA UPLAND (MWANZA LAKE-SHORE COTTON) VS. LOCAL U/4/4/2.

Two half drill strip experiments were carried out. Each variety A B B A couplet was replicated eight times. The results were calculated by the analysis of variance.

Results.—Both experiments showed a significant difference in favour of the local U/4/4/2 cotton. The figures were calculated in seed-cotton and in terms of lint. The ginning percentages were taken as 31·5 per cent for the Mwanza Lake Shore cotton, and 34·5 per cent for the U/4/4/2 variety.

Experiment No. I.

(a) SEED COTTON FIGURES.—The mean difference was greater than the standard error of the mean difference by 6·2 times which is significant. Standard error of mean difference=4·551 mean of mean differences=28·56. U/4/4/2 showed an increase in yield of 71·5 pounds per acre which is a 15·4 per cent increase. *Yield mean per acre* U/4/4/2=534lb. Mwanza=462lb.

(b) LINT FIGURES.—In terms of lint the results are yet more significant. The mean difference was greater than the standard error of the mean difference by 47·7 times. Standard error of mean difference=·3883, mean of mean differences=18·56.

The increase in yield per acre was 46lb. which is a 32 per cent increase. Yield mean per acre U/4/4/2=189·0lb. Mwanza=143·0lb.

Experiment No. II.

The mean difference was greater than the standard error of the mean difference by 13 times, which is significant. Standard error of mean differences=2·41 mean of mean differences=32·5. The U/4/4/2 showed an increase in yield of 81·2lb. per acre which is a 19 per cent increase. *Yield mean per acre* U/4/4/2=540lb. Mwanza=458lb.

(b) LINT FIGURES.—In terms of lint the figures were again more apparent. The mean difference was greater than the standard error of the mean difference by 71 times. Standard error of mean difference=·2901, mean of mean differences=20·73.

The increase in yield per acre of U/4/4/2 over Mwanza was 51·80lb., which is 37 per cent. *Yield mean per acre* U/4/4/2=191·60lb. Mwanza=139·80lb.

(ii)—*Observation and Selection Work.*

The following one-sixth acre observation plots were laid down and a comparative study was made during the year:—

(i) *Barberton Selections.* 955, 998, U/4/4, 052, 921, 0239, 0245, 0342, 0343, 0344, 9292, 9243, U/4 Bulk.
(ii) *Local Cotton.* U/4/4/2.
(iii) *Local Selections.* L7, L8, L12.
(iv) *Gattoma Selections.* U/4/64/7/10, U/4/78/3/5/2.
(v) *Ukiriguru Selections.* Uganda Upland types Mwanza 561, 570, 576, 572.
(vi) *Mwanza Bulk.*
(vii) In addition field scale plantings of 998, 955, U/4 Bulk and U/4/4/2 were done. These yielded 437, 305 and 323 pounds of seed-cotton per ecre respectively over approximately twenty-five acres each.

Single plant selections were made from the above plots during the year, and also from the district cotton, these will be carried forward and planted this coming year. Approximately two hundred selections were made. Analytical work was carried out on the above varieties. The most promising varieties are 998, 955, 921, L8, L12, 0343, 0342, 0344. Of the Uganda Upland types Mwanza 561, 572 and 576 contained many plants of promise.

The Cotton Manurial Experiment.—This experiment gave no significant results. The planting was delayed due to the delay in receiving the manures from Mwanza.

Climatic Conditions.—By and large the conditions were unfavourable to the growth of cotton. The rainfall distribution was very uneven, torrential downpours were followed by long spells of hot dry weather.

Pests and Diseases.—Conditions were favourable to the incidence of disease. In April and May all cottons suffered from a severe attack of jassid. Considerable damage was also done by Dysdercus, and American and spiny boll worms. The percentage of stained cotton at harvest amounted to nearly fifty per cent. It is interesting to note that no strain proved outstanding regards its resistance to jassid. Taken as a whole the U/4 derivatives showed a higher resistance than the Uganda Upland types but none of the U/4 types displayed the resistance to jassid which they normally do in their place of origin. It would appear that the Shinyanga area constitutes the borderline for the successful growing of this type. A more jassid resistant type is what is required. A. U/4-Cambodia cross has been suggested for trial during the coming year.

3.—OTHER EXPERIMENTAL WORK.

1. *Awned Bulrush Millet vs. Native Bulrush Millet.*—Half Drill, replicated eight times.

Results : No significant difference in yield between the two types was obtained. The awned millet was grown on account of its reputation of being immune to damage by birds. Although no significant differences were obtained, it is considered that the awned types have a certain amount of resistance to damage, especially from small birds. Further selection work is required as there was a considerable variation in the degree of awnedness.

2. *Native Groundnuts vs. Virginia Bunch.*—Half Drill strip, replicated eight times. Each variety was planted at its optimum spacing and the land was tie-ridged. Information was required as to the relative merits of each variety if planted at their optimum spacings.

The native variety gave a very significant increase in yield. The mean difference was greater than the standard error of the mean difference by 150 times.

SECTION IV.—THE NATIVE AUTHORITY SEED FARM.

1.—GENERAL.

Quite apart from the production of seed supplies for the ultimate distribution to the natives, the seed farm acted as a training centre, a demonstration farm and a ploughing school.

2.—MULTIPLICATION OF SEEDS.

The following quick maturing varieties of seeds were grown for distribution purposes. These have been sent out to the areas of potential famine and

have been exchanged on a *quid pro quo* basis by the respective native chiefs.

Feterita sorghum ... ... 15,000lb.
Virginia Bunch groundnuts ... 2,200lb.

In addition awned bulrush millet was grown and sent out to the areas severely infested with Striga. Over ten thousand pounds of this seed was exchanged.

It was decided that the free issue of seed was undesirable and that the exchange method should be adopted. It has proved very popular and the demand for seed was keen.

3.—EDUCATION.

A small adult school is in its inception, for those illiterate natives wishing to become better agriculturists. The buildings and equipment await the approval of the native treasury estimates. During the interim period evening classes were started for those who wished to attend.

An agricultural training centre for the instruction of literate natives for employment as agricultural instructors, market supervisors and produce graders is also in its inception.

The Ploughing School.—Facilities were provided throughout the year for those natives who wished to learn to plough or who wished to have their oxen trained. In addition, in order to popularize the use of ploughs, the small Indyebo ploughs (two or four oxen) were hired out to the natives with oxen for the charge of two shillings a day. Many natives availed themselves of this facility. Since harvest time several small ploughs have been sold to natives, and orders have been placed for the purchase of inter row cultivators.

4.—INDIVIDUAL NATIVE HOLDINGS.

Two individual native holdings were started during the year at Lubaga, and two at Ibadakuli, with the object of demonstrating to the natives the advantages of mixed farming and a settled type of agriculture, as opposed to their shifting methods of agriculture. These holdings which were started primarily for demonstration purposes served also as experimental holdings for the acquisition of information on mixed farming under the local conditions.

These demonstrational peasant holdings were laid out on the following lines :—

(i) *Unit of Holding.*—(a) Personnel : A family of three persons. (b) Stock : five head; three working animals, two dairy cows.

(ii) *Size of Holdings.*—twenty acres. (a) Under cultivation : ten acres. (b) Under grazing, tree planting, etc. : ten acres.

(iii) *Policy of the Holdings.*—The policy of the holdings was designed to provide—(a) an adequate supply of food for his family and stock; (b) to provide cash for his requirements; and (c) to maintain the holding in good heart.

(iv) *Cropping of the Holding.*—The cropping of the holding quite apart from the three main objectives, was such as to distribute the peasants' work as evenly as possible throughout the season, to provide roughage for the manufacture of farmyard manure, and to maintain the stock in a fit condition for work throughout

the year. This was made possible by the introduction of a simple four-course rotation and the use of quick maturing crops such as Feterita sorghum and Virginia Bunch groundnuts.

The four-course rotation which was started was :—

1st Year.—Farmyard manure then Pennisetum.

2nd Year.—Cotton.

3rd Year.—Sorghum.

4th Year.—Groundnuts followed by green manure.

The cropping of the area under cultivation was :—

Food Crops. Two acres native sorghum;
one acre Feterita millet;
one acre maize under planted with beans.
one acre house plot, beans, vegetables, pigeon pea, etc.

Cash Crops. Two acres cotton;
one acre groundnuts.

Stock Food. One acre Pennisetum;
one acre maize cut green or half acre elephant grass;
half acre maize.

In spite of the late start which was made with these holdings, satisfactory results were obtained. At Lubaga the holders obtained the following yields per acre :—

No. 1 Asumani.	*No. 2 Lugando.*
Maize, 1,250lb.	Maize, mostly picked green.
Groundnuts, 400lb.	Groundnuts, 114lb.
Cotton U/4/4/2, 400lb.	Cotton, Barberton 998, 534lb.
Pennisetum, 585lb.	Pennisetum, 480lb.
Feterita Millet, 582lb.	Feterita Millet, Failed.
Sorghums, 685lb.	Sorghums, 112lb.

The figures of the No. II holding are considerably lower than those of No. I, with the exception of the cotton. This was undoubtedly due to the late occupation of the holding. They cannot be taken as average figures for area.

Equipment.—Each holder was given a house, etc., cattle shed, a small plough (Indyebo), three working oxen, two milking cows and seed for planting.

These holdings have been the source of a considerable amount of interest among the local natives. It is intended, after the water supply is assured, to divide up the perimeter of the two thousand acre reserve and establish a settlement of peasant farmers.

J. G. M. King,
Agricultural Officer

Annexure IX

UKIRIGURU EXPERIMENTAL STATION AND UZINZA EXTENSION FARM.

Progress Report.

The general weather conditions were fair but the rains were abnormally long, extending over a period of eight and a half months, compared to the average of six months. The dry spell between the early rains and the main rains was severe and held up plant growth.

2. Although an excellent season for many crops, cotton on the farm and in the neighbourhood made poor development, the cold wet weather towards the end of the season resulting in abnormal type of growth of all plants and heavy boll shedding. Cotton yields were low and the percentage stained was high.

3. *Cotton Work.*—The testing of strains was carried out in two strain trials; these made poor development but, although all strains were severely damaged, it was possible to compare the selections and five strains of promise were isolated, two of these repeating their good performance of last year. U/4/4/2 from Shinyanga was included in one of the strain trials to compare with the new selections; in yield of seed-cotton it was placed sixth out of the fourteen selections.

4. In a variety trial of local cotton, U/4/4/2 and two mass selected mixtures of local cotton (Uganda Upland), U/4/4/2 gave the highest yield of 213 pounds per acre compared to 193 pounds per acre given by a mass selection from local cotton, the local giving 184 pounds per acre. Unfortunately the differences were not enough to give significance owing to the extreme variation in the trial.

5. The progeny plots of 1934 field selections were severely attacked by capsid and the resulting structural damage and heavy flower and boll shedding which took place so masked the inherent possibilities of the selections that, with the exception of a few which went down to the slight attack of jassid, they are to be tried in the progeny plots for another year.

6. *Insect Pests.*—Damage by insect pests of the cotton on the farm and in other areas was severe. This has been found to be due to injury by capsid and the typical symptoms are strong monopodial growth with abnormal lengthening of the internodes, malformation and holing of the leaves resulting in heavy flower and boll shedding. Observation in previous years showed the damage to be most severe in cold wet seasons and still more intense in low-lying areas. No direct control measures are known, but cultivators were advised to avoid cotton growing in the heavy valley bottoms.

7. During the dry spell in January there was a heavy aphis infestation which, although damaging plants, disappeared with the main rains.

8. A large population of stainers was present and the percentage of stained cotton was high, over thirty per cent, and in a number of cases barely sufficient seed stocks of strains has been obtained for future plantings. Other pests, although present, did comparatively little damage.

9. *Rotation Crops.*—Considerable progress was made with other rotational crops as weather conditions were more suited to them.

10. *Sorghums.*—Three variety trials in which thirty-five native sorghums were tested have given valuable results. The trials were carried out in order to obtain data on yields, characteristics, and resistance to damage by striga and insect and fungoid pests. Certain varieties have proved superior to the majority. The work of classification and the data obtained has reached a point at which selections within these varieties can now be carried out.

11. Observation work on introduced varieties show that none are of any special merit. Feterita, a three-months sorghum from the Sudan, proved a valuable early crop but a number of characteristics show that it is of limited application.

12. *Millet.*—Two trials resulted in proving that the introduced awned bulrush millet is not a superior yielder to the native millet on the lighter soils, but it gave excellent yields on a multiplication plot on heavy black soil and may be more suited for cultivation on such areas. The presence of awns makes it partly resistant to damage by birds, a controlling factor in millet cultivation, but constant selection is required to maintain this characteristic.

13. *Groundnuts.*—A trial between the local native mixture of groundnuts, Virginia Bunch and Manyema, a variety from another district, gave significant results in favour of the local type.

14. At a second trial in which a Barberton strain was compared with Basse, Philippine White and Mwitunde, a selection from the local mixture of groundnuts, the newly introduced Barberton proved a markedly superior yielder and, in addition, gave very low rosette disease counts compared with the others. The Barberton strain yielded 932 pounds per acre of shelled nuts with 76·5 per cent shelling percentage.

15. Other introductions and selections were planted in observation plots and progeny rows but none of outstanding merit was isolated.

16. *Maize.*—Introduced Kenya Hybrid maize gave high yields and has proved suited to local conditions, provided early planting is carried out. Selections from native maize were tried and, although not such good yielders as the introduced Kenya Hybrid, are more suited to native cultivation as planting can be carried out over a wider range of planting dates owing to the shorter period to maturity.

17. *Minor Crops.*—The raising of cassava from seedlings in attempt to obtain strains resistant to mosaic disease gave no result. Trials of various crops, both food and fodder crops, have shown the following to be of definite value: Dolichos bean as a fodder crop, tepary bean, a quick maturing food crop, elephant grass as a fodder crop, and ironbark pumpkin as cattle feed.

18. *Cultural Experiments.*—The maintenance of fertility of native holdings by various treatments in order to allow a fixed tenure is the basis of most of our agricultural improvements and a number of manurial trials were carried out.

19. *Kraal Manure.*—The residual effect of a dressing of seven tons per acre of kraal manure, dry cattle manure, applied to bulrush millet in 1932 gave this season a significant increase in yield of grain of 31 per cent in favour of the treated plots. The increases in 1932 and 1933 were 33 and 49 per cent respectively in favour of the treatment.

20. Dressings of three, six and nine tons per acre of kraal manure applied to cotton in 1934 gave no significant increase in yield that year. The residual effect was tested this season with bulrush millet. Significant results were

not obtained owing to the seepage from the heavily manured plots but the three, six and nine tons per acre treatments yielded respectively 855, 865 and 976 pounds per acre grain compared with 795 pounds per acre from the untreated plots.

21. A trial of three rates of dressing, two five and eight tons per acre applied to Pennisetum in 1934 gave no significant results that season, due it is thought to the dry state of the soil. The residual effect was tested with cotton and the application at the rate of eight tons gave a highly significant increase in yield of seed-cotton of 62 per cent over control which yielded 247 pounds. The two tons per acre gave an increase at the rate of 36 per cent; the five tons per acre dressing gave an increase of eighteen per cent but this was not sufficient for significance.

22. *Farmyard Manure.*—Properly made farmyard manure was available for the first time this season and dressings of one, three and five tons per acre applied to millet were tried. Significant increases in yield were obtained. From dressings of one, three and five tons per acre increases of 29, 20 and 33 per cent over control which yielded 619 pounds per acre, were obtained.

23. *Green Manuring.*—In areas where fly precludes the keeping of stock the alternative method of maintaining soil fertility by green manuring should be practised or it may be supplementary to the use of farmyard manure. A trial laid down in 1932 in which a six-weeks' growth of sunn hemp was planted previous to a quick maturing groundnut crop gave no increase in the yield of groundnuts, but the following year bulrush millet from the treated plots yielded 7·9 per cent greater than the untreated; cropped with cotton this season no significant result was obtained.

24. It was considered that native cultivators would not be prepared to lose an area of their land from their cropping area by taking a green manure crop and it was decided to test the value of various green manures, planted after the main crop was removed, on the next season's crop. Sunn hemp, four and a half tons per acre, bulrush millet four tons per acre, and sunflower five tons per acre were dug in at the end of last season and all plots cropped with bulrush millet this season. A significant increase of 67 per cent over control, which yielded 444 pounds per acre of grain, was the result from the sunn hemp treatment. Other treatments gave increases but not high enough to be significant.

25. The value of both kraal manure and farmyard manure in dressings which may be considered small in raising the fertility level of heavily cropped areas such as Mwanza, is apparent. Although the action of kraal manure may be delayed in a dry season, it is available for future crops and whether the native cultivator keeps his stock in open yards or houses he has the means at hand of raising his yields per acre provided he will take the trouble to carry out the manures on to his land. The long term effect of manuring such soils has yet to be ascertained, but it is unlikely that any condition will arise which will make manuring uneconomic.

26. The use of green manure, of which sunn hemp appears to be the most promising, requires the cultivator to plant some early quick maturing crop which allows the green manure crop to be dug in before or after his food or cash crop and frequent applications will be necessary to maintain fertility.

27. *Rosette disease.*—The inhibition of rosette disease of groundnuts due to close planting and delayed weeding which gave significant results in the two past seasons this season only gave results slightly in favour of close

planting and delayed weeding, but the incidence of rosette disease was not high, owing to damp weather conditions.

28. *Labour requirements.*—The practice of timing native hand cultivation was again carried out and the data obtained is the time taken for one man to prepare and plant by hand one acre of each of the various crops. The after cultivation and harvesting are not given as it is the time taken to cultivate and plant in the short planting season which is the limiting factor to the area a native can crop :—

Sorghum	... ...	10 days	... Yield 475lb. grain.
Maize	... ...	15 ,,	... ,, 1,520 ,, ,,
Millet	... ...	14 ,,	... ,, 508 ,, ,,
Cotton	... ...	12 ,,	... ,, 220 ,, seed cotton.
Groundnuts	... ...	18 ,,	... ,, 1,000 ,, shelled nuts.

29. *Mixed Farming.*—On the seed farm which is run in conjunction with the experimental section cattle are used as far as possible and the experience gained is of great value in framing the policy and lines of work for the cultivators who have taken up mixed farming under our control.

30. The feeding of stock is perhaps the most important point in mixed farming practice and it has been found that the work oxen can be kept in good condition and female stock give yields of milk much above those obtained by natives, due to the provision of feed which any cultivator can obtain. Although grazing is very limited, very full use has been made of it by the practice of tethering, and this coupled with roughage such as maize stover, groundnut haulms from the arable land and small quantities of elephant grass grown specially as fodder, has maintained all stock in excellent condition.

31. The making of millet hay and maize silage, the former yielding three and three-quarter tons per acre and the latter twelve tons per acre, have been successfully carried out, but only as the stock owner realizes the benefit of good feeding can he be expected to carry out such practices of his own free will. A small sun-dried brick silo, ten feet in diameter and five feet deep was tried this season and good silage was taken from it. This type of silo can easily be made by natives and should be useful where it is impossible to dig pit silos.

32. The most promising fodder crops proved this season were elephant grass, Dolichos bean, ironbark pumpkin and bulrush millet hay. Edible canna, and velvet bean although making fair growth have not proved suitable for widespread cultivation.

33. *Ideal Native Holdings.*—Four new holdings on the perimeter of the farm were taken up this season but as they started very late they were not asked to carry out the full cropping scheme. The two established settlers have done well. They harvested good crops and worked their holdings on the lines laid down for them and there is no doubt that a much greater acreage than that cultivated by the ordinary cultivator can be cropped and fertility improved under the system of mixed farming. The condition of their stock is a striking example of what better feeding and housing can do for the native cattle.

34. The total number of hours worked on each holding during the season of 300 days averaged 2,776 which, taking it that both man and wife worked the same amount, is just over four and a half hours work per day per individual. The cash return this season was much lower than last, averaging thirty-four

shillings per holding; this was due to their poor cotton crops and the fact that they consumed all milk which previously they had sold. Against this their food crops were excellent, and actually there is a surplus available for sale. Their standard of living is high with their better housing and very ample food supplies, being much better than most native cultivators.

35. With practice in using their work oxen the holders have been able to use the wooden plough and cultivator to a much greater extent, and they are now asking for imported implements, but as the former have proved capable of the work demanded they are to continue with these until they can purchase improved implements out of their own earnings.

36. *Development of Station.*—A number of much needed improvements and alterations were carried out on the station during the year. A house was built for the Agricultural Officer in charge close to the farm and necessary alterations carried out to the Agricultural Assistant's house. Other building work included the erection of a new store and workshop, a new cattle shed, compost house, maize crib, an underground water tank and quarters for the African staff. The dam at the end of the farm was enlarged and deepened and a spillway built.

37. The area of the cultivated land remains the same, but resiting of a number of plots was carried out and with a certain amount of extra drainage and tree planting, major works will be completed.

38. The establishment of a rice station at Mwabogole on the Lake shore was completed, and twenty acres of land can be irrigated by the pumping plant. Although primarily for rice improvement it is also to be used for the multiplication of various seed stocks during the dry season.

39. *Uzinza Extension and Settlement Farm.*—The area selected in Uzinza to serve as a cotton multiplication farm was brought a step nearer its purpose. The main development work carried out during the year was the clearing of a further 190 acres for cultivation and the clearing of a large area of bush around the building site as a protection from "fly."

40. The building programme was started and the following buildings are being erected: Residential quarters for the Agricultural Assistant, a small ginnery and workshop, two cotton stores, a cattle shed and an office. In addition to quarters for the African staff, permanent labour lines are to be built to replace the temporary camp erected last season.

41. The year's cropping was disappointing and although this is partly due to the light rains recorded during the cropping season and damage by locusts, this is not a complete explanation. Owing to shortage of labour cultivation and planting was carried out late.

The following yields of cotton were obtained:—

(a) 10 acres Mass selected cotton ... ... 282lb. per acre.
(b) 15 ,, Local cotton ... ... 227 ,, ,,
(c) 20 ,, ,, ,, ... 137 ,, ,,

The twenty acres on (c) were planted after maize which was destroyed by locusts.

42. Small acreages of bulrush millet and Virginia Bunch groundnuts were grown for seed for distribution to settlers on the farm and did well.

43. *Settlers.*—The thirty-eight settlers who had taken up holdings on the farm made fair progress. The large amount of clearing and preliminary cultivation entailed did not allow them to get a full acreage under crops, but with one or two exceptions they have passed through their first year well,

and have obtained sufficient food and cash crops to carry them through. Until their position is consolidated, they have not been asked to carry out any extra work and improved practices are to be introduced gradually.

44. A number of new twenty-acre holdings have been marked out, some of which are already taken up, and it is hoped to induce settlers to take up the balance this season.

D. Thornton,
Agricultural Officer, Ukiriguru

IHEME EXPERIMENTAL STATION.

Introduction.

1. The rainfall during the year was 30·08 inches. Temperatures were unusually low in July and frost occurred in the valley bottom.

Development.

2. The main work carried out during the year was development hence the experiment work is still very restricted.

3. *Buildings.*—One large barn, 25 feet by 12 feet by 16 feet, and two smaller ones, each 12 feet by 12 feet by 16 feet, were completed for fire-curing tobacco. The conditioning cellar commenced last year was completed and a large working and grading shed, 50 feet by 12 feet, was completed. The roofing timbers in one dwelling house were found to be infested with wood borer, and the roof had to be removed and new timber put in. The third cattle house commenced last year was thatched and a concrete floor laid down.

4. *Afforestation.*—Approximately seven acres of windbreaks were planted with *Eucalyptus maculata, E. citriodora, E. globulus* and *E. corynocalyx.* The black wattle windbreaks were thinned to 12 feet by 12 feet. Approximately ten acres were cleared and holed for planting when the rains commence, and the edges of the entrance road are being holed for the planting of an avenue.

5. *Shambas.*—Six acres were cleared and terraced for *Aleurites fordii* and almonds. The *shamba* below the orchard was contour ridged. The central *shamba,* intended for the main experimental work, was also contour ridged.

6. *Irrigation Furrow.*—It was recorded last year that the furrow was nearing completion. The sub-soil is, however, too soft and sandy for the original width of the furrow, and in consequence widening is being carried out to prevent collapse of the portion already dug. Owing to scarcity of labour the work was not completed.

Compost.

7. Composting by the Indore method, modified to suit local conditions, was continued and is still being experimentally modified to shorten the period of preparation. The chemist of the Veterinary Department is co-operating in this work and a preliminary analysis is now being done.

Virginia Tobacco.

8. *Fire-cured tobacco.*—The pure line selection work commenced four years ago with the variety Heavy Western is being carried on. This variety is, however, particularly susceptible to the physiological disease known as "red rust" which is very prevalent in the district. Seed of Heavy Western was produced and sold for all fire-cured tobacco production, but it would seem that sooner or later this variety must be discarded if something better can be found. To this end a number of varieties were obtained from the United States of America and were planted to obtain acclimatized seed. When this has been done all the varieties will be planted for observation and the number reduced by elimination to the bounds of a variety trial of which statistical analysis can be made.

9. *Flue-cured tobacco.*—As yet no variety has been selected that is suitable for producing this type of tobacco in the cold growing conditions of this area. The same procedure is being adopted to select varieties as is being done for the fire-cured types.

10. *Varieties.*—The following main varieties of both types are under observation :—

Variety	Source
Amorello	South Africa
Greenwood	Ontario, Canada
White Steam Willow Leaf	,, ,,
Bonanza	,, ,,
Gold Tip	,, ,,
Burley (Harrow 1009)	,, ,,
Hickory Pryor	,, ,,
Warne	,, ,,
Virginia Bright	,, ,,
Yellow Mammoth	,, ,,
Cash	,, ,,
White Stem Oronoco	,, ,,
White Stem Pearl	,, ,,
Stand-up White Burley	Kentucky, U.S.A.
Smith's Improved	,, ,,
Brown Leaf	,, ,,
Penn. seed leaf	,, ,,
Zimmer Spanish	,, ,,
Little Oronoco	,, ,,
Jamaica	Georgia, ,,
Maryland Mammoth	,, ,,
Burley Mammoth	,, ,,
Florida Hybrids	Florida, ,,
3 hybrids	Germany
Clarksville (?) Sel/Iheme/No. 3	South Africa

Turkish Tobacco.

11. Work on this type is being cut down as the Virginia types have displaced it in the district. A small crop was planted for seed of the varieties Soulook, Xanthi, Kirs, Serees and Revika. Brokers in England, who expressed particular interest in samples of Xanthi, have been informed that there is no production worth mentioning and in consequence the despatch to them of the trial bales foreshadowed last year will not take place unless they can offer prices that will tempt planters from their Virginia type production.

Wheat.

12. The area of Nguruhe, which produces the bulk of the wheat, presents problems different from those of the area in which the station lies, hence the experiments were carried out on a farm in the Nguruhe area itself.

Experiment I.—To determine what forms of wheat stem rust are prevalent in the area. To this end thirty-three varieties and strains, many of which are known to be susceptible to different forms of stem rust, were planted either in single rows or in plots that were parts of other experiments. Specimens of every form of apparent disease infection were submitted to the Plant Pathologist. Small infections of *Puccinia triticina* were found but no stem rust. Unfortunately (for the experiment) this year all wheat in the district was singularly free from rust hence the trial must be repeated.

Experiment II.—The following five varieties which were obtained from Kenya were compared, using a latin square lay-out :—

Variety	Yield lbs. per acre
(1) B.59.A.9.3.1(L)	185
(2) B.60.B.12.B36.A2(L)	1,220
(3) B256.G	1,211
(4) Sabanero	949
(5) B112.E.8(L)	976

Summary.—(1) was a significantly lower yielder than the other four. There was no significant difference in yield between (2), (3), (4) and (5).

Experiment III.—The three following varieties were selected for trial after two years' observation :—

(1) B.256.
(2) Kenya Standard.
(3) N.B.2(6)3.H(L).

Summary.—No significant difference was found between these varieties.

Experiment IV.—Observation of fifteen German varieties (at request of German community), one Italian and one South African variety. Planted in randomized blocks. Observations : All the German varieties are useless under the Nguruhe conditions and in most cases did not mature. The South African variety yielded practically nothing. The Italian variety, Mentana, yielded and behaved sufficiently satisfactorily for inclusion in next year's trial.

Miscellaneous Crops.

13. *Cossack alfalfa.*—This was planted two years ago for observation as a permanent cover crop for coffee. On digging up it was found to have an enormous root development in the top 50cm. which makes it unsuitable for the purpose for which it was originally tried. On the other hand it is stated to be very drought resistant and a sowing is being made to observe its possibilities as a stock feed.

14. *Cover crops.*—Twenty acres were planted with Bonavist beans but growth was unsatisfactory evidently as temperatures are too low.

15. *Nuts.*—The almond, Pecan nut and Queensland nut trees are still too young for report.

16. *Other Fruits.*—Peach varieties, Improved Waldo, Killiekrankie, Shackleford and Florida Crawford, all on local peach stock, have borne satisfactory small first crops. The imported peaches are, however, unsatisfactory and have made very poor growth. Apples are still backward as also are nectarines. Plums are satisfactory but have not borne yet. Grape vines are now commencing to bear. They have been trellised on the three-wire method. The ten olive trees show great promise. They are now three and a half years old. Figs are promising and have borne a good first crop.

17. *Kudzu vine.*—This shows most promise as a stock feed when planted in a soil that remains moist throughout the year. Weight of green material is not available in time for this report.

18. *Pelargonium radula.*—Approximately two hundred cuttings were obtained from Lushoto and of these ten per cent struck. The growth has been very rapid and cuttings from the established plants are rapidly increasing the material for setting out a block.

C. J. McGregor,
Agricultural Officer

APPENDIX I.

List of European Staff as on 31st December, 1935.

Director: E. Harrison, c.m.g., on leave.

Deputy Director: A. J. Wakefield, Head Office, Morogoro.

Senior Agricultural Officers: A. S. Richardson, on leave; C. K. Latham, on leave; R. M. Davies, Moshi.

Agricultural Lecturer: A. E. Haarer, Maswa.

Chief Scientific Officer: S. M. Gilbert, Coffee Research and Experimental Station, Lyamungu, Moshi.

Entomologist: A. H. Ritchie, Bukoba.

Assistant Entomologist: W. V. Harris, on leave.

Plant Pathologist: G. B. Wallace, Coffee Research and Experimental Station, Lyamungu, Moshi.

Chemist: H. B. Stent, Coffee Research and Experimental Station, Lyamungu, Moshi.

Agricultural Officers: J. V. R. Brown, Mwanza; C. B. Garnett, Lindi; D. Sturdy, on leave; C. Harvey, Bukoba; A. S. Stenhouse, Biharamulo; H. Marsland, Mpanganya, Rufiji; C. J. McGregor, Iheme, Iringa; A. H. Savile, Bukoba; N. V. Rounce, Morogoro; T. C. Cairns, Kigoma; R. D. Linton, Tabora; B. J. Hartley, m.b.e., Arusha; F. R. Sanders, Coffee Research and Experimental Station, Lyamungu, Moshi; J. Robertson, Mpanganya, Rufiji; F. W. Thomas, Tukuyu; R. B. Allnutt, Lindi; J. R. Curry, Moshi; N. R. Fuggles-Couchman, Dar es Salaam; G. W. Lock, Sisal Experiment Station, Ngomeni, Tanga; D. Thornton, Ukiriguru, Mwanza; J. G. M. King, Shinyanga; J. C. Eyre, Tanga; N. M. Wight, Experiment Station and Head Office, Morogoro; H. Gillman, Bukoba; T. H. Marshall, on leave; R. J. M. Swynnerton, Lushoto.

Agricultural Officers (Ginnery): P. W. Briggs, Mwanza; N. Field, Morogoro.

Senior Agricultural Assistants: T. S. Jervis, Bukoba; C. J. M. Krige, Kilosa.

Agricultural Assistants: E. T. Ward, on leave; R. W. Collett, Mpapura, Mikindani; L. Leslie-Moore, on leave; G. S. Brown, Dar es Salaam; B. E. Eustace, on leave; A. Taylor, on leave; W. Sibley-Warne, Mpanganya, Rufiji; W. C. Clarke, Ukiriguru, Mwanza; A. Young, Moshi; L. F. Higgens, Moshi; R. Seager, Uzinza Extension Farm, Mwanza; A. E. Twells, Songea; A. E. Weirich, Same; H. L. Brett, Bugufi, Biharamulo; H. A. B. Fowler, Sisal Experiment Station, Ngomeni, Tanga; B. R. D. Eccles, Shinyanga; R. Silcock, Morogoro Extension Farm, Kingolwira; C. B. Gibbins, Coffee Research and Experimental Station, Lyamungu, Moshi.

Senior Overseer, Agricultural Stations: G. H. Foster, Morogoro.

District Foremen: C. E. Allen, Tunduru; A. F. Crosskill, Kilwa; J. T. McGregor, Songea; C. Holland-Smith, Nzega; N. W. E. McDermott, Tabora; J. J. Malan, Morogoro.

Chief Clerk: Vacant.

European Clerks: C. H. Taylor, Coffee Research and Experimental Station, Lyamungu, Moshi; D. F. T. Brown, Head Office, Morogoro; J. B. Hean, Head Office, Morogoro.

APPENDIX II.

Plant and Seed Introductions, 1935.

Dutch Marrowfat Peas	from	Kenya.
Soya Bean seed	,,	,,
Aleurites fordii (cluster type)	,,	,,
Velvet Beans var. Osceola	,,	Queensland, Australia.
,, ,, ,, Bunch	,,	,, ,,
,, ,, ,, Mauritius (Black)	,,	,, ,,
,, ,, ,, ,, (Green)	,,	,, ,,
Coffea arabica	,,	The United States of America.
Melon seed	,,	Khartoum.
Lolkaswali Wheat seed	,,	South Africa.
Morgenster Marvel maize seed	,,	,, ,,
Pinus pinaster seed	,,	,, ,,
Poplar cuttings	,,	,, ,,
Sweet potato tubers (4 varieties)	,,	Southern Rhodesia.
Onion seed (thrips resistant)	,,	Iraq.
Fodder sorghums (4 varieties)	,,	Ceylon.
Tokar cotton seed	,,	Sudan.
Pishori rice seed	,,	Punjab.
Cotton seed (4 selections)	,,	Uganda.
Barley seed	,,	Pusa, India.
Pigeon Pea seed	,,	,, ,,
Gram seed	,,	,, ,,
Lentil seed	,,	,, ,,

APPENDIX III.

List of Ginneries Existing in 1935.

Province and District	Locality	Last licensed	Number of Gins		Licensee
			Saw	Roller	
Eastern:					
Dar es Salaam	Ruvu ...	1935/36	1	26	Vithaldas Haridas & Co., Ltd.
,,	Pugu ...	,,	1	18	Abdulrasul and Sons
Morogoro ...	Morogoro ...	,,	1	22	Tanganyika Cotton Co., Ltd.
,, ...	Mikesse ...	,,	—	21	East African Cotton Co., Ltd.
,, ...	Ngerengere ...	,,	—	16	Liverpool-Uganda Co., Ltd.
,, ...	Mlali ...	1930/31	—	18	Tanganyika Cotton Co., Ltd.
,, ...	Duthumi ...	1935/36	1	18	,, ,, ,,
,, ...	Mkata ...	1930/31	—	12	,, ,, ,,
,, ...	Turiani ...	1931/32	—	13	,, ,, ,,
Kilosa ...	Kilosa ...	1935/36	—	18	Juma Haji
,, ...	*Kimamba ...	,,	—	12	Kimamba Planters Ginning Co., Ltd.
,, ...	Rudewa ...	,,	1	22	Tanganyika Cotton Co., Ltd.
,, ...	Msowero ...	,,	—	14	Kladitis and Samaris
Bagamoyo ...	Mandera ...	,,	—	16	Liverpool-Uganda Co., Ltd.
,, ...	†Kisauke ...	1928/29	—	2	S. G. Drosopoulos
Rufiji ...	Kilimani ...	1935/36	—	12	Kilimani Plantation
,, ...	Msomeni ...	,,	—	8	Liverpool-Uganda Co., Ltd.
,, ...	Logeloge ...	,,	—	8	D. Kepetsakos
Mahenge ...	Kiberege ...	,,	—	12	Vithaldas Haridas & Co., Ltd.
Lindi:					
Lindi ...	Lindi ...	1931/32	—	13	Mathuradas Kalidas
,, ...	Mtua ...	1935/36	—	14	,, ,,
Kilwa ...	Kikanda ...	,,	1	10	Kikanda Cotton Trading Co., Ltd.
Mikindani ...	Mikindani ...	1934/35	—	5	Mathuradas Kalidas
Tanga:					
Tanga ...	Tongoni ...	1929/30	1	8	G. Galanos
Handeni ...	Mamundu ...	1928/29	1	—	Kwashemshi Estates
,, ...	Sindeni ...	1935/36	1	3	,, ,,
Northern:					
Moshi ...	Moshi ...	,,	—	12	Moshi Trading Co.
,, ...	Himo ...	,,	1	13	,, ,,
Mbulu ...	Idulu ...	,,	—	8	M. Michaelakis
Western:					
Shinyanga ...	Usogore ...	,,	4	6	Bhagwanji Sunderji & Co.
,, ...	Luhombo ...	,,	4	—	,, ,, ,,
Lake:					
Mwanza ...	Mwanza ...	1935/36	—	20	Nakasero Trading Co.
,, ...	Murutunguru	,,	1	20	White Fathers' Mission
,, ...	Ihale ...	,,	—	14	Mwanza Cotton Trading Co.
,, ...	Bukumbi ...	,,	—	13	Bhagwanji Sunderji & Co.
,, ...	Nyanguge ...	,,	—	14	Lake Province Cotton Co.,
,, ...	Nassa ...	,,	—	20	Narandas Rajaram & Co. (Africa), Ltd.
Kwimba ...	Nyambiti ...	,,	2	14	Lake Province Cotton Co.
,, ...	Pambani ...	,,	—	17	Kampala General Agency
,, ...	Runere ...	1930/31	5	—	Bhagwanji Sunderji & Co.
Maswa ...	Malampaka	1935/36	5	13	,, ,, ,,

*Non-Native cotton only. †Private ginnery.

APPENDIX IV.

EXPERIMENTAL STATIONS.—Rainfall (in millimetres) for the year 1935.

	January	Feb.	March	April	May	June	July	August	Sept.	October	Nov.	Dec.	Total for the Season
Coffee Experimental Station, Lyamungu	2·8	236·2	107·6	312·0	715·8	155·8	39·7	45·3	11·7	22·7	73·1	103·0	2025·7
Nyakato School, Bukoba	37·9	399·1	306·3	190·1	263·1	78·0	Nil	46·8	34·0	208·1	146·4	310·8	2020·6
Iheme, Iringa ...	101·3	186·4	230·4	71·1	5·1	Nil	Nil	0·3	Nil	4·6	19·0	135·9	754·1
Morogoro	3·8	124·1	229·3	68·2	229·5	50·0	1·0	22·5	25·9	28·1	42·5	107·5	932·4
Sisal Experimental Station, Mlingano	Nil	103·9	263·6	155·1	157·3	103·1	1·2	48·0	134·8	34·5	103·9	147·4	1252·8
Ukiriguru, Mwanza	87·6	85·6	137·7	145·8	62·0	23·0	Nil	3·6	28·0	15·0	50·3	147·3	785·9
Lubaga, Shinyanga	108·3	301·9	39·0	226·6	21·1	22·2	Nil	Nil	Nil	24·0	22·3	158·8	924·2
Mpanganya, Rufiji ...	80·2	214·7	147·7	21·1	102·6	29·7	Nil	6·8	22·2	126·5	144·2	115·5	1011·2